MONTHLY WEATHER REVIEW.

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INTRODUCTION.

The MONTHLY WEATHER REVIEW for July, 1905, is based on data from about 3486 stations, classified as follows:

Weather Bureau stations, regular, telegraph, and mail, 176; West Indian Service, cable and mail, 4; River and Flood Service, regular 52, special river and rainfall, 363, special rainfall only, 98; cooperative observers, domestic and foreign, 2565; total Weather Bureau Service, 3258; Canadian Meteorological Service, by telegraph and mail, 33; Meteorological Service of the Azores, by cable, 2; Meteorological Office, London, by cable, 8; Mexican Telegraph Company, by cable, 3; Army Post Hospital reports, 18; United States Life-Saving Service, 9; Jamaica Weather Service, 130; Costa Rican Meteorological Service, 25. Total, 3486.

Since December, 1904, the Weather Bureau has received an average of about 1700 reports from as many observers and vessels, giving international simultaneous observations over the Atlantic and Pacific oceans at 12 noon, Greenwich time, or 7 a. m., seventy-fifth meridian time. These are charted, and, with the corresponding land observations, will form the framework for daily weather charts of the globe.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. S.I. Kimball, General Superintendent of the United States Life-Saving Service; Commander H. M. Hodges, Hydrographer, United States Navy; H. Pittier, Director of the Physico-Geographic Institute, San José, Costa Rica; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels Azores; W. N. Shaw, Esq., Secretary, Meteorological Office, London; H. H. Cousins, Chemist, in charge of the Jamaica Weather Office; Señor Enrique A. Del Monte, Director of the the Meteorological Service of the Republic of Cuba; Rev. L. Gangoiti, Director of the Meteorological Observatory of Belen College, Havana, Cuba.

Attention is called to the fact that at regular Weather Bureau stations all data intended for the Central Office at Washington are recorded on seventy-fifth meridian or eastern standard time, except that hourly records of wind velocity and direction, temperature, and sunshine are entered on the respective local standards of time. As far as practicable, only the seventy-fifth meridian standard of time, which is exactly five hours behind Greenwich time, is used in the text of the REVIEW. The standards used by the public in the United States and Canada and by the cooperative observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is 157° 30′, or $10^h\ 30^m$ west of Greenwich. The Costa Rican standard meridian is that of San José, $5^h\ 36^m$ west of Greenwich.

Barometric pressures, whether "station pressures" or "sea-level pressures", are now reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

In conformity with Instructions No. 43, March 29, 1905, the designation "voluntary", as applied to the class of observers performing services under the direction of the Weather Bureau without a stated compensation in money, is discontinued, and the designation "cooperative", will be used instead in all official publications and correspondence.

FORECASTS AND WARNINGS.

By Prof. A. J. HENRY, temporarily in charge of Forecast Division.

July was free from very destructive storms and hurricanes. Somewhat less than the usual number of atmospheric disturbances passed across the country, and the majority of them reached the Atlantic coast with greatly diminished energy. The first noteworthy disturbance appeared over the Plateau region on the 1st, whence it moved to Nebraska on the morning of the 2d and thence to the region north of Lake Superior, where it apparently dissipated on the 6th. The only storm warnings of the month on the Great Lakes were displayed in connection with this storm. The warnings were generally verified. From the 14th to the 20th a shallow disturbance without rain moved from Assiniboia to the Canadian Maritime Provinces. This disturbance was attended by a hot spell in the north-central and northeastern districts which, although not productive of unusually high temperatures, was the cause of a large number of prostrations and deaths in the densely populated centers of the Middle West, the Middle Atlantic States, and the southern portion of New England. This hot spell was preceded in the New England and Middle Atlantic States by a number of days with southerly winds and high relative humidity. The night temperatures on the 17th, 18th, and 19th, particularly in Boston, New York, Philadelphia, and Chicago, were unusually high, viz, between 72° and 78°. On the afternoon of the 19th the intensity of the hot spell was somewhat reduced by local rains, and temperatures continued to fall during the next 48 hours, passing from one extreme to the other in about three days. The cool spell thus inaugurated was due in part to an area of high pressure that passed eastward over the Lake region on the 21st. The cool weather was experienced mainly in the Dakotas and Nebraska and thence eastward to New England. The close of the hot spell was forecast on the morning of the 19th, as follows:

> The outlook for thunderstorms during the next 36 hours in the upper Ohio Valley and thence eastward is fairly good. With the showers there will be more or less fall in temperature Thursday afternoon or night, and it now seems probable that the prevailing high temperatures will be temporarily interrupted by Friday.

From the 20th to the close of the month two shallow depressions drifted across the country from the Rocky Mountains to the Atlantic, both attended by more or less showery weather and moderate temperatures.

A period of unusually high temperature was experienced in the interior valleys of the Pacific coast States, more especially California, from the 4th until the 10th, and again on the 20th, 21st, 22d, and 23d. Except along the immediate Pacific coast the temperatures west of the Rocky Mountains for the month as a whole were not greatly different from the average. The tracks of areas of high pressure were confined mostly to the

northern portion of the country. The highs themselves diminished in energy after reaching the Lake region, only to increase again on reaching the Atlantic.

NEW ENGLAND FORECAST DISTRICT.

The weather was of the midsummer type, and devoid of special features. While the temperature over the entire district was practically normal, a period of unusually oppressive weather, with high per cent of humidity and warm nights obtained from the 8th to the 20th, inclusive, during which there were numerous prostrations and a number of deaths. The precipitation was normal to excessive in the northern portions and generally deficient in the southern portions of the district. The usual number of severe electrical storms and downpours of rain occurred, which, in a number of instances, resulted in much damage to property and some loss of life. There were no windstorms or heavy gales, and no storm warnings were issued during the month.—*J. W. Smith, District Forecaster, Boston, Mass.*

NORTH-CENTRAL FORECAST DISTRICT.

The most prominent feature of the month was the warm wave of the second decade, which was attended by the highest temperatures of the present summer. This warm wave was an apparent result of the persistent southwest winds and dry weather in the central valleys and over the Great Plains that attended low barometric pressure in the Northwest and high pressure over the South Atlantic States. The termination of the warm period in this district was accurately forecast. Storm warnings were ordered, except for western Lake Superior, in connection with a rather severe storm that advanced over the upper Lake region on the 4th. Low temperature for the season was indicated for the cranberry marshes of Wisconsin on the 23d and 24th, and advices were issued that the minimum in the marshes would be 32° to 40°. Frost was not, however, forecast. A minimum of 35° was reported at Grand Rapids, Wis., the night of the 25th. On July 31, light frost was forecast for Minnesota, the low-lying sections of Wisconsin, and the interior of northern Michigan. Frost was reported at Duluth, Minn., and Escanaba, Mich., on the morning of August 1. An area of showers, heavy in some localities, drifted over the district from the 25th to 28th, their occurrence being announced in the forecasts.—*E. B. Garriott, Professor of Meteorology, Chicago, Ill.*

CENTRAL FORECAST DISTRICT.

The month was marked by numerous thunderstorms and heavy rains, but no very destructive storms. Well defined disturbances passed over the district on the 9–10th and the 21st–22d, causing more or less severe local storms and heavy rainfalls. The rain periods were 1st–4th, 6–13th, 20th–23d, and 28–29th. The temperature was about normal with practically only one heated period, the 15–20th.—*Ferdinand J. Walz, District Forecaster, Louisville, Ky.*

WEST GULF FORECAST DISTRICT.

No special warnings were issued and there were no disturbances along the Gulf coast during the month. Frequent showers occurred over the eastern and northern portions of the district causing a heavy monthly rainfall. The showers were generally covered by the forecasts of the Bureau. Very few verifying temperature changes occurred during the month.—*I. M. Cline, District Forecaster, New Orleans, La.*

ROCKY MOUNTAIN FORECAST DISTRICT.

The month was cooler than usual on the eastern and southern slopes. Thunderstorms were forecast for New Mexico daily from the 19th to the 27th, inclusive. During the first two days of this period the rainfall was light, but after the 21st heavy local downpours occurred in the Capitan, Sacramento, and Guadalupe mountains. Coincident with the coming of the flood waters from the mountains, heavy rains set in at lower altitudes to the eastward. These rains caused some quite severe floods of which mention is made in the subsequent article on Rivers and Floods.—*F. H. Brandenburg, District Forecaster, Denver, Colo.*

SOUTH PACIFIC FORECAST DISTRICT.

A well marked area of high pressure began moving inland from the ocean on the 1st and caused a steady rise in temperature, commencing in California on the 2d and in Nevada on the 3d. A severe warm wave developed over the entire district on the 4th, reaching its crest on the California coast on the 7th, in the interior of the State on the 8th, and in Nevada on the 9th. During this period the temperatures at many places reached or exceeded all previous records. In the interior valleys, temperatures of 115° and 116° were reported. Some fruit was injured by the heat, but otherwise the damage was slight. The greater portion of the month was marked by temperatures slightly below the normal in the interior and by cool, foggy weather on the coast.—*G. A. Willson, Local Forecaster, Temporarily in Charge, San Francisco, Cal.*

NORTH PACIFIC FORECAST DISTRICT.

No special warnings were required and none were issued. Beginning on the 20th an area of low pressure formed over the interior of the district, where it remained until the end of the month. Some few thunderstorms resulted from this distribution of pressure, but in general the weather was dry and warm. About the 26th the atmosphere became smoky west of the Cascade Mountains and two days later the smoke spread to include most of the district. All rivers and streams fell to an unusually low stage.—*Edward A. Beals, District Forecaster, Portland, Oreg.*

RIVERS AND FLOODS.

During the month there were quite a number of floods, limited as to territory, yet comparatively destructive. The rivers principally affected were the Mississippi within the State of Minnesota; the Missouri and its tributaries from South Dakota to Missouri; Spring River of Missouri and Indian Territory, an important tributary of the Neosho; the White River of Arkansas; and the Pecos River in New Mexico and Texas. There were also several rises of comparatively unimportant character in the Red, the James River of Virginia, and the rivers of North Carolina and South Carolina.

The Minnesota floods were caused by heavy rains from the 3d to the 6th, inclusive, and danger-line stages prevailed until the middle of the month. At St. Cloud, Minn., the highest stage was 7.2 feet, 3.2 feet above the danger line, on the 8th and 9th; and at St. Paul 14.8 feet on the 11th, 0.8 foot above the danger line, the highest stage reached since 1897. Warnings of the floods were issued whenever necessary, but the flood waters did considerable damage to river farms, particularly in Aitkèn County. In the vicinity of St. Paul and Minneapolis considerable inconvenience was caused by the flooding of the flats.

The Missouri River flood was of fair proportion and much damage was done, especially in the vicinity of Pierre, S. Dak., where the Teton, or Bad River, as it is popularly known, was in flood after the heavy rains of the 2d and 3d, and caused the loss of seven lives and a great amount of property. Seventeen houses, several with their entire contents, in Fort Pierre, S. Dak., were swept down the Missouri and the bridge across the Red River was carried away. The losses are estimated to have been from $75,000 to $100,000. The river gage was carried away during the night of the 3d and 4th, so that no record of the stage of the water could be obtained; a record may be obtained by survey. Considerable damage was also done between Sioux City and Kansas City, where the stage of water varied from two to five feet above the danger lines. Farmers in the lowlands were the principal sufferers.

The Spring River flood caused the loss of one life and property to the extent of several hundred thousands of dollars. No flood service is maintained on this river.

Warnings were issued whenever possible for these floods and also for the rises in the Red, the James, and the rivers of North Carolina and South Carolina. The following report on the Pecos River flood was prepared by Mr. F. H. Brandenburg, Official in Charge, U. S. Weather Bureau office, Denver, Colo.:

After the 21st heavy local downpours occurred in the Capitan, Sacramento, and Guadalupe mountains. Coincident with the coming of the flood waters from the mountains, heavy rains set in over the lower altitudes to the eastward. Only moderate stages prevailed in the Pecos above Roswell, N. Mex., but below that point the river rose rapidly, as each tributary was at flood stage. The Penasco and Felix washed out a county bridge and some railroad bridges. The Hondo, which empties into the Pecos near Roswell, was reported to be very high, but there was no serious damage owing to the protection afforded by the new dikes. On the 26th the stage of the Pecos at Carlsbad was 14.2 feet, and on the morning of the 28th, near Pecos, Tex., the gage showed 18.3 feet, or a rise of ten feet in 48 hours. After remaining practically stationary for 24 hours the river fell rapidly, falling below the danger line on August 1.

Interests at Roswell were advised on the morning of the 23d that a sharp rise in the Hondo was expected, and the general manager of the Barstow Irrigation Company, at Barstow, Tex., was informed of the heavy rainfall in the mountain districts. On this date there was a scarcity of water for irrigation, the gage reading at the flume at Barstow being only one foot. On the morning of the 25th all points between Carlsbad and Barstow were advised of approaching flood stages. To Pecos and Barstow the following warning was sent: "High water by Thursday night, 27th; river will continue rising." While for other points up stream the time set was correspondingly earlier. These timely warnings were fully appreciated, and resulted in the saving of much property.

The flood in the White River of Arkansas began on the 29th after two days of excessive rainfall over the watershed, and by the close of the month danger-line stages were general, with the river still rising. Warnings were first issued on the 28th. A report of this flood will appear at a later date.

The highest and lowest water, mean stage, and monthly range at 279 river stations are given in Table VI. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Divison.

The following summaries relating to the general weatlfer and crop conditions during July are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon reports from cooperative observers and crop correspondents, of whom there are about 3300 and 14,000, respectively:

Alabama.—Rainfall heavy to locally excessive in some northern, middle, and southwestern counties, insufficient elsewhere. Cotton made fairly good growth and fruited moderately well until latter part of month, when crop was deteriorating over half the State, with rust spreading and shedding becoming general; grown bolls numerous by 20th, some opening during last few days. Corn and minor crops advanced fairly well; early corn maturing and late corn earing well last decade, when considerable fodder was pulled.—*F. P. Chaffee.*

Arizona.—Frequent, though light, local rains and thunderstorms last half of month revived vegetation generally and afforded a plentiful water supply for irrigation and stock. Wheat, barley, and oat harvest completed in south and central portions 15th. Second and third alfalfa cuttings not finished in northern and central sections; fourth crop blooming in southern. Light frost 15th and hail 19th and 26th damaged gardens and fruit. Large grape shipments. Stock thrifty. Late corn crop making good growth.—*L. N. Jesunofsky.*

Arkansas.—Unusually cool and wet. Farm work greatly retarded. Cotton made slow growth, was small, did not fruit well, and was injured by insects locally; some fields were abandoned on account of weeds. Early corn was laid by; late suffered from lack of cultivation and too much moisture. Wheat and oat harvest progressed slowly; some grain injured in shock by moisture. Apples and peaches deteriorated.—*O. C. Burrows.*

California.—Clear, seasonable weather prevailed in the interior and cool, foggy weather in the coast sections most of the month. The temperature was abnormally high in nearly all sections on the 7th and 8th, and in many places previous records were broken. Grapes, berries, and deciduous fruits were considerably injured by the heat. The hay crop was nearly all gathered and was the best for several years. Grain harvesting was nearing completion.—*Alexander G. McAdie.*

Colorado.—The prevailing droughty conditions in the southern and western parts of the State were effectively broken by showers toward the close of the month. During the last decade the harvesting of winter wheat, rye, and barley was progressing satisfactorily, as also that of spring wheat in Weld County, and the second crop of alfalfa in the Arkansas Valley; oats were ripening, and corn, beets, and potatoes were making good growth.—*F. H. Brandenburg.*

Florida.—The month gave normal temperature and practically the average amount of precipitation. The cotton crop did very well during the first part of the month, except over the western portion, where the weather was too dry. As the month advanced rain came more regularly and was frequently locally heavy, doing damage to cotton in central and northern districts. Late corn was improved, and a large acreage was set to sweet potatoes. Cane, citrus trees, pineapples, and minor crops did well.—*A. J. Mitchell.*

Georgia.—Temperature was about normal; rainfall irregular, most too wet the first and second decades, too dry the third. Cotton grew rapidly, made too much weed at expense of forms, needed rain at end of month, some fields grassy, injury by black root, lice, rust, and shedding; began to open south 25th. Early corn variable; late varieties injured by rain first and by drought last of month. Fodder and hay being saved last decade. Peach and melon shipping about completed, latter good crop, former below average. Minor crops generally good. Large crop of peas.—*J. B. Marbury.*

Hawaii.—Weather warm and sultry during entire month, with rainfall considerably above the normal in many sections. Some damage occasioned to growing cane at intervals by high winds, but conditions otherwise generally favorable for rapid progress. Grinding of 1905 cane nearly finished, with a satisfactory yield; planting for 1907 crop continues. An exceptionally fine summer crop of pineapples being harvested; plants in excellent condition. Second crop of rice being planted. Coffee picking begun. Leeward pastures, except in higher levels, short during most of month.

Idaho.—The first half of the month was generally rather cool; the latter half was excessively hot in western and northern counties, causing some damage to late oats and spring wheat. Fall sown and early spring wheat yielding well. Corn made good growth. The portion of the hay crop harvested was average or above, but in some localities late crops suffered owing to scarcity of water. Grass on lower ranges became very short and dry, but in most instances stock found ample subsistence in higher mountains.—*Edward L. Wells.*

Illinois.—The month opened cool, with temperatures decidedly below the seasonal average. In low places in parts of the northern district light frost formed, but no damage was reported. During the first decade the harvesting of oats was begun in the central and southern districts, and wheat was mostly in shock and some thrashing had been done. At the end of the month corn was earing out nicely, having maintained a fine condition throughout the month.—*Wm. G. Burns.*

Indiana.—Cutting of wheat practically finished before middle of July. During the latter part of month cutting oats, making hay, and thrashing wheat progressed rapidly and generally with satisfactory results as to output and quality of crops. Corn made good growth and was mostly laid by in good condition. Cucumbers, tomatoes, melons, and tobacco did well and field onions improved. A large crop of blackberries was gathered.—*W. T. Blythe.*

Iowa.—July was deficient in temperature and rainfall, but there was sufficient warmth and moisture to promote the normal growth of corn, potatoes, and vegetables, and ripen wheat, oats, barley, and rye. Some hindrance was caused by showery and cloudy weather the first half of month, but during the latter part conditions were generally favorable for hay and grain harvest, with good yield secured. Corn in good condition at close of month. Apple crop very light.—*John R. Sage.*

Kansas.—Wheat harvest was over by the 15th, except in a few extreme northern counties; thrashing and stacking progressed rapidly, showing a fair yield and good quality. Corn grew rapidly and continued in fine condition; it was tasseling, silking, and earing in northern counties at close of month. Oat harvest finished, with fair yield and good quality. Prairie haying and fall plowing begun. Apples and potatoes good. Cutting third crop alfalfa began the last week.—*T. B. Jennings.*

Kentucky.—Temperature above normal at opening of month and again from 15th to 17th, but averaged slightly deficient. Precipitation in excess of normal, except in extreme northern and several western counties. Wheat harvested and thrashed, with slight damage from wet weather; yields varying. Oats and rye thrashed and stacked in good condition, with some slight damage from moisture. Hay plentiful, but poor. Tobacco generally vigorous, but needing cultivation; mostly topped and some cutting commenced. Fruit falling badly.—*F. J. Walz.*

Louisiana.—Showery weather prevailed during the greater portion of

the month, which favored a rapid growth of vegetation, but materially interfered with the cultivation of crops. Cotton suffered seriously as a result of the inability of planters to kill grass and weeds. Many fields of cotton were abandoned during the month and generally the crop made very little progress, the condition being much below the average for this season of year. Sugar cane grew rapidly and as a rule the conditions were excellent. Rice was irregular; harvest and thrashing under way. Corn was in poor condition. Truck gardens made satisfactory growth.—*I. M. Cline.*

Maryland and Delaware.—July was unusually wet, with temperature about normal. Wheat saved in fair condition, and where properly dried results were satisfactory, but much early thrashed was damp. Good crop oats harvested. Corn fodder heavy and ears began to shoot. Much hay spoiled by rain, crop light. Pears and apples fair. Peaches scarce. Tobacco on light soil poor, on firm soil a short crop. Tomatoes fruited poorly and ripened too slowly. Early potatoes rotted badly.—*C. F. von Herrmann.*

Michigan.—Frequent showers during first half of month interfered with field work, especially in central and southern counties, but drier weather during latter half was very favorable to haying and harvest work. A large hay crop and a very good wheat yield were generally well secured during the latter half of month. Oats, corn, late potatoes, and sugar beets made good growth throughout the month. Oat harvest was well under way at close of month. Buckwheat seeding germinated well. Apples, on account of wet weather, became scabby and dropped badly. Peaches and pears continued in good condition.—*C. F. Schneider.*

Minnesota.—High temperatures from 14th to 19th gave corn splendid start. Considerable rain early and late in month. Meadows flooded and rivers very high early in month. Spring wheat, oats, barley, and flax heading on southern highlands early in month. Winter wheat and barley cutting began about 15th, and spring wheat cutting on 26th. Black rust infection widespread on 20th, but no injury resulted. Stacking barley and rye and thrashing from shock late in month.—*T. S. Outram.*

Mississippi.—Frequent and heavy rains hindered cultivation over much of the State. Upland cotton grew rapidly, but generally fruited poorly. Lowland cotton continued small and was only beginning to bloom at the close of the month. Many grassy fields were abandoned. Complaints of rust, blight, and shedding were serious in some northern and eastern counties. Old corn matured and fodder pulling was commenced. Young corn, peas, cane, potatoes, and meadows were generally in good condition. The fruit crop was poor.—*W. S. Belden.*

Missouri.—Weather during July was generally favorable, although excessive precipitation in southern counties caused more or less damage to grain in shock and to crops and property along the smaller streams subject to overflow. Corn made vigorous growth and at the close of the month was well advanced toward maturity. Grain thrashing made fair progress where not hindered by rains. Cotton made good growth. Considerable hay was damaged. Potatoes and all minor crops were looking well.—*George Reeder.*

Montana.—Favorable temperatures prevailed, being normal or above, except for one or two brief periods. Rainfall above normal and well distributed. Haying progressed favorably. Wheat, oats, rye, and barley made vigorous growth; winter wheat harvest began the last week. Range grass remained green and cattle and sheep were in excellent condition. Garden vegetables and small fruit abundant. Apple trees heavily loaded and fruit excellent.—*R. F. Young.*

Nebraska.—Winter wheat harvest was completed, with exceptionally favorable weather. Thrashing began and winter wheat proved to be an excellent yield of fine quality. Oat harvest progressed rapidly. An excellent crop of prairie hay was partly secured, but much remained to be cut. Corn was small early in the month, but made an excellent growth. It tasselled about ten days later than usual and was in excellent condition at the end of the month.—*G. A. Loveland.*

Nevada.—The month was remarkably dry, with two periods of unusually warm weather, from the 4th to 10th and 19th to 25th. Nearly cloudless skies prevailed the entire month. Haying and harvesting progressed without interruption. Vegetable crops did well in localities supplied with irrigation water. Range feed dried up rapidly, though stock continued in good condition. Insect pests damaged garden truck greatly in several places.—*J. H. Smith.*

New England.—The weather of the month was generally pleasant, with more than the usual number of clear days and without special features. The maximum temperatures, as a rule, occurred in the second decade and the closing days were cool. The precipitation was somewhat excessive in some northern sections and deficient over most of the southern portion of the district. The weather conditions were generally favorable for crop growth and for harvesting.—*J. W. Smith.*

New Jersey.—The month was noted for the very uneven distribution of rainfall, which came in the form of showers. Some portions of all sections received an excess and others a marked deficiency. Crops, especially potatoes and apples, were greatly shortened in the droughty portions. The harvesting of wheat, rye, hay, and oats was completed and the crops housed in fine condition. Thrashing was in progress.—*Edward W. McGann.*

New Mexico.—Previous to the 19th showers were insufficient, streams low, stock water scarce, and range grasses dry and browning. Stock, however, remained in good condition, and the heavy showers of last decade fully revived range grasses, field crops, gardens, alfalfa, and fruits, and renewed the water supply. Considerable flood damage occurred in southeastern districts. Reaping and thrashing of small grain and harvest of second crop alfalfa continued slowly throughout the month, good grain yields being generally secured. Fruits were abundant and excellent.—*Charles E. Linney.*

New York.—The month as a whole was favorable for crops and farm work. The temperature was generally above normal until the 20th and below after that date. Precipitation was fairly well distributed. Hay, wheat, and rye were mostly secured in good condition, and the cutting of barley begun. Oats and corn improved very much, and beans, hops, tobacco, and sugar beets made fairly satisfactory growth. Apples, pears, and plums deteriorated somewhat, but peaches and grapes did well.—*W. C. Devereaux.*

North Carolina.—The month of July was not so favorable as June for the growth of crops. The first decade of the month was very good, but after the 10th heavy rains continued for a week, flooded lowlands, and caused considerable damage. Cotton was growing satisfactorily in a great many places, but shedding and rust were frequently reported. Tobacco was injured slightly by excessive rains, but was generally doing well. Thrashing of grain was about over. Other crops doing nicely. Fruit poor.—*A. H. Thiessen.*

North Dakota.—The temperature was slightly lower than the average and the precipitation considerably in excess of the usual amount, making the month a very favorable one for farming operations. All crops made excellent progress, except flax and corn, it being too cold and wet for them. Red rust had made its appearance in most grain fields, and some black rust was also found, but no material damage was done by either.—*B. H. Bronson.*

Ohio.—Corn improved rapidly during the month, but was weedy and uneven; earliest tasseling and earing well. Wheat harvesting and thrashing continued, with yields varying from fair to good; some damage by rust and weevil reported in the north. Oat and rye cutting and thrashing were well advanced toward the end of the month; good yields reported. Potatoes fair. Some tobacco being topped. Apples, pears, and plums poor crops. Peaches and grapes fair to good.—*Harry O. Geren.*

Oklahoma and Indian Territories.—The month was cool and wet. Wheat and oats thrashed out poor to good yields. Fall wheat plowing well advanced. Early corn maturing and doing well. Cotton improved and squaring, fruiting, and bolling; some not fruited well, but generally in fair to good condition. Broom corn, cane, alfalfa, millet, potatoes, hay, and fruit giving fair to good yields. Range good and stock doing well.—*C. M. Strong.*

Oregon.—July was favorable for harvesting hay and grain. The bulk of the hay crop was secured during this month, and it turned out to be extra good, both in quantity and quality. The barley harvest began early and the cutting of wheat began by the 15th. Fall sown wheat and barley yields were above the average, but spring sown wheat and oats were disappointing. Corn did extra well. Early potatoes were plentiful in the markets.—*Edward A. Beals.*

Pennsylvania.—As a whole the weather during the month was favorable for farm work and the advance of growing crops and, at its close, a large acreage of hay and oats had been secured in good condition. Pastures were furnishing ample feed.—*T. F. Townsend.*

Porto Rico.—Weather generally favorable, except in the southwestern section, where a drought prevailed throughout the month. Cotton badly damaged by worms, especially in the southeast portion of the island. Coffee abundant; quality not yet determined. Cane grinding about completed in most sections. Young cane would have been generally benefited by more rain. Good rice crop gathered. Small fruits in general abundant and of good quality.—*A. L. Brockway.*

South Carolina.—There were two periods of excessive heat, but the ground was so well supplied with moisture that the conditions were tropical in the luxuriant growth of all vegetation. Cotton attained an unusual size, and in places fruited well, while in others not so well; on sandy lands deterioration set in during the last decade, due to rust and shedding. The month was altogether favorable for corn and minor crops.—*J. W. Bauer.*

South Dakota.—Crops materially damaged on some flooded lowlands early in the month, but generally spring wheat, oats, barley, rye, spelt, corn, flax, and potatoes made good progress. Grass was excellent and haying was favorably advanced. At the close of the month wheat harvest had begun south, but there was considerable complaint of smut and scattered fields showed a little, but not damaging, black rust; oat and spelt harvest was well under way; barley cutting was well advanced; early flax was bolling; and in the southern counties early corn was silking.—*S. W. Glenn.*

Tennessee.—The weather was very wet from the 1st to the 12th, seriously interrupting the cultivation of crops and saving of hay and grain, and damaging much grain. The fair weather of the 13th to 20th was followed by a showery spell lasting to the end of the month. Early corn was generally good, but late plantings were in bad condition at the end of the month. Cotton was overgrown and weedy. Tobacco was in very good condition. Wheat yielded a poor crop. Oats were fairly good. The

SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS, JULY, 1905.

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.								Precipitation—in inches and hundredths.					
			Monthly extremes.								Greatest monthly.		Least monthly.	
	Section average.	Departure from the normal.	Station.	Highest.	Date.	Station.	Lowest.	Date.	Section average.	Departure from the normal.	Station.	Amount.	Station.	Amount.
Alabama	79.4	— 0.7	Thomasville	103	22	Riverton	55	26	4.56	—0.66	Mobile	9.18	Notasulga	1.08
						Camp Hill	55	27						
Arizona	79.2	— 1.5	Parker	127	7	Flagstaff (a)	36	2	1.02	—0.69	Alpine	3.95	4 stations	0.00
Arkansas	76.7	— 3.3	Lacrosse	106	14	Mountainhome	51	4	7.60	+3.66	Dodd City	22.35	Brinkley	1.84
California	74.8	— 0.5	Volcano Springs	128	5	Bodie	18	16	0.01	—0.04	Yreka	0.48	Many stations	0.00
Colorado	64.2	— 2.4	Las Animas	103	17	Wagon Wheel Gap	24	2	2.05	+0.09	Lake Moraine	6.65	Fruita	0.07
						Antelope Springs	24	5						
Florida	81.5	0.0	Orange City	102	4	DeFuniak Springs	61	16	7.55	+0.03	Inverness	19.67	Jasper	2.30
						Molino	61	12						
Georgia	80.3	+ 0.2	Hawkinsville	104	20	Dahlonega	54	26	4.57	—1.21	Clayton	13.13	Hawkinsville	0.66
Hawaii	†74.5	.....	Kihei, Maui	94	30	Humuula, Hawaii	35	2	‡5.33	.....	Nahiku, Maui	25.59	Ewa, Oahu	0.08
Idaho	68.3	.....	Glenns Ferry	113	23	4 stations	30	3 dates	0.33	.....	Idaho Falls	1.12	4 stations	0.00
Illinois	73.2	— 2.6	Chester	99	16	Lanark	45	24	4.93	+0.89	Chester	13.56	La Salle	1.49
			Lagrange	99	17									
Indiana	73.9	— 1.7	Rome	100	17	Kokomo	45	25	4.59	+1.56	Mount Vernon	10.64	Kokomo	1.45
Iowa	70.6	— 3.8	Waukee	102	16	Washta	40	25	2.91	—1.44	Albia	7.08	Washta	0.69
Kansas	74.5	— 3.6	Medicine Lodge	108	18	Hoxie	34	3	5.55	—1.48	Fort Scott	11.45	Garden City	0.86
Kentucky	75.9	— 0.8	Paducah	102	16	Beaverdam, Burnside, Scott	52	26	5.93	+1.09	Alpha	10.48	Scott	1.40
Louisiana	80.2	— 1.6	Reserve	106	15	Amite	59	7	8.52	+2.47	Covington	14.57	New Orleans	3.93
						Mansfield	59	11						
Maryland and Delaware	75.3	— 0.6	Md. Ag'l College, Md.	101	18	Deer Park, Md	42	9, 25	7.36	+2.80	Bachman's Valley, Md.	14.70	Newark, Del	2.86
			Milford, Del											
Michigan	67.7	— 1.1	Jackson	97	17	Wetmore	24	21	4.31	+1.31	Traverse City	7.46	Humboldt	0.56
Minnesota	67.3	— 2.3	Wabasha	100	16	Angus	38	23	4.12	+0.59	Mount Iron	9.44	Caledonia	0.69
						Pine River Dam	38	25						
Mississippi	79.1	— 2.0	Magnolia	102	16	Magnolia	58	7	4.57	—0.77	Woodville	10.58	Holly Springs	1.50
Missouri	73.4	— 3.8	Princeton	101	16	Fulton, Louisiana	48	25	7.45	+3.21	Lockwood	17.98	Princeton	2.35
Montana	65.9	0.0	Hayden	101	21	Fort Logan	25	2	1.52	+0.16	Graham	3.38	Saltese	0.00
			Troy	101	22	Grayling	25	5						
Nebraska	70.4	— 3.7	Hooper, Leavitt	102	16	Agate	38	9	4.67	+1.16	Beaver City	13.90	Winnebago	1.20
Nevada	72.1	— 0.7	Sodaville	109	12	Potts	31	17	0.03	—0.53	Halleck	0.40	15 stations	0.00
			Martins Ranch	109	21									
New England*	69.9	+ 0.2	Norwalk, Conn	98	3 dates	Van Buren, Me	38	21	3.63	—0.68	Cornish, Me	9.11	Lowell, Mass	0.59
						Grafton, N. H	38	22						
New Jersey	74.4	— 0.4	Somerville	102	18	Layton	42	26	4.06	— 0.95	Plainfield	8.19	Atlantic City	1.67
						Charlottesburg	42	26, 27						
New Mexico	70.9	— 1.8	Carlsbad	109	12	Winsor's	30	1	2.65	—0.55	Elk	15.10	Albuquerque	0.22
New York	70.2	+ 1.0	3 stations	99	18	Indian Lake, North Lake.	35	22	5.08	+0.69	Moira	10.73	Coeymans	0.67
North Carolina	77.3	— 0.4	Pinehurst	105	3	Linville	46	26	7.90	+2.35	Linville	6.90	Henderson	3.89
North Dakota	65.6	— 2.7	Dickinson	100	11	Cando	32	8	3.90	+1.44	Minnewaukon	6.91	Buford	0.68
						Hannaford	32	17						
Ohio	73.0	— 0.8	Bladensburg	100	10	Canal Dover	44	1, 2	3.93	+0.09	Colebrook	7.65	Cincinnati	1.04
Oklahoma and Indian Territories.	77.7	— 2.8	Chickasha, Ind. T.	107	30	Kenton, Okla	46	10	5.50	+2.32	Hartshorne, Ind. T.	11.60	Newkirk, Okla	1.64
Oregon	68.6	+ 3.4	Umatilla	115	21	Bend	30	14, 17	0.16	—0.31	Newport	0.86	21 stations	0.00
						Silver Lake	30	18						
Pennsylvania	72.6	+ 0.4	Hanover	99	18	Coudersport	39	27	4.87	+0.30	Greenville	9.78	Springmount	2.49
			Philadelphia (c)											
Porto Rico	78.9	.....	Manati	97	2	Adjuntas	53	22	6.12	.....	San Lorenzo	12.91	Isabela	1.63
South Carolina	80.4	+ 0.5	Bowman, Winnsboro	101	4	Darlington	60	21	6.16	+0.65	Calhoun Falls	14.29	Saint George	3.15
			Dillon	101	21	Walhalla	60	26						
South Dakota	68.5	— 3.5	Elk Point	101	16	Ramsay	38	9, 24	3.69	+1.28	Fort Meade	10.33	Brookings	0.98
Tennessee	76.4	— 1.0	Arlington, Pope	99	17	Silver Lake	49	26	4.32	—0.46	Silver Lake	10.09	Centerpoint	1.28
Texas	80.6	— 2.0	Comanche	112	30	Texline	45	10	4.06	+1.20	Bonham	13.91	Rockport	0.00
Utah	71.5	— 0.1	Thistle	112	11	Thistle	26	4	0.52	—0.07	Ranch	2.28	6 stations	0.00
Virginia	75.4	— 0.6	Cape Henry	98	18	Blacksburg	34	29	7.18	+2.64	Buchanan	13.13	Petersburg	3.19
Washington	67.6	+ 1.2	Mottinger's Ranch	114	21	Cusick	33	8, 14	0.35	—0.31	Sedro-Wooley, Snohomish.	1.54	6 stations	0.00
West Virginia	73.3	— 0.7	Moorefield, Romney	98	17	Bayard	43	26	5.92	—2.17	Burlington	10.64	Nuttallburg	3.00
Wisconsin	68.1	— 2.1	Darlington	100	16, 18	Grand Rapids	35	26	3.67	—0.31	Sturgeon Bay	8.90	Prairie du Chien	1.45
Wyoming	61.6	— 2.7	Basin	102	11	3 stations	27	3 dates	1.69	+0.51	Pine Bluff	5.21	Dubois	0.14

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. † 46 stations, with an average elevation of 649 feet. ‡ 127 stations.

apple crop was short and quality poor. The hay crop was good.—*Roscoe Nunn.*

Texas.—Generally warm, but cool at end of first and beginning of second decade. Too much rain northeast and east and too little south. In the northwest rainfall was favorable for crops. Cotton improved, except in northeast and east, where rains were injurious. Boll weevil and boll worm increased early in month, but diminished later. Picking was quite general in southwest by end of month. Corn improved during month. Rice and sugar cane did well. Grain was damaged by rain. Grass and stock did well.—*M. E. Blystone.*

Utah.—Hot and dry first portion of month; general thunderstorms and cooler second decade; light showers and much warmer toward close of month. Where irrigated, crops did remarkably well; arid farms in some sections were suffering. Small grain matured rapidly and was being extensively harvested, with average yields. Haying general, with good crops reported. Corn improved and tasseling. Abundance of superior potatoes being dug. Garden truck and fruit were maturing fast. Sugar beets promised well. Ranges drying, but stock doing well. Water becoming scarce.—*R. J. Hyatt.*

Virginia.—Harvest of winter wheat and oats was nearly completed and that of spring oats well advanced during the month. Thrashing was much delayed by persistent rains which, with warm and humid conditions, caused considerable injury to the grain. Corn made excellent progress. Tobacco did not do well until the latter part of the last decade, when some improvement occurred. Gardens and minor crops were generally very good. Fruit, especially apples, continued to fall and was generally scarce and inferior.—*Edward A. Evans.*

Washington.—The weather was in general, although not altogether, favorable to the growth and development of crops. Scarcity of rain dried up pastures and meadows and affected oats on uplands. Dry and hot winds at the beginning of the third decade caused considerable burning or shriveling of late spring wheat and oats. Winter wheat and early

spring grain were not injured. Corn, potatoes, and hops made satisfactory progress.—*G. N. Salisbury.*

West Virginia.—Hot, showery weather prevailed during the first three weeks, and was very beneficial for crop growth. The cutting of hay and oats and the stacking of wheat were considerably delayed, but the fourth week was very favorable for this work. Corn made rapid growth and was very promising. Pastures and stock were in fine condition. Millet, buckwheat, cowpeas, cabbages, and gardens were doing well.—*E. C. Vose.*

Wisconsin.—The month was characterized by a deficiency of rainfall, moderate temperature, a good supply of sunshine, and severe local hailstorms. Tobacco was damaged considerably by hail and grains were generally lodged by high winds. Corn made rapid headway. Hay was well secured and was an unusually large crop, nothwithstanding damage by adverse weather conditions earlier in the season. Spring grains made good progress. Pastures and meadows were in excellent condition. Fruits and berries were a heavy yield. Sugar beets continued in fine condition. The apple crop was not in satisfactory condition.—*J. W. Schaeffer.*

Wyoming.—The weather was favorable for the growth of grain and gardens, which made favorable progress; at the close of the month gardens were in excellent condition, and a good crop of grain was beginning to ripen in the earlier sections. A good crop of native hay was being secured, but showers interfered with its harvest. Ranges continued excellent and cured very slowly, in some sections remaining green to the close of the month. All stock was in excellent condition.—*W. S. Palmer.*

SPECIAL ARTICLES.

STUDIES ON THE DIURNAL PERIODS IN THE LOWER STRATA OF THE ATMOSPHERE.

By Prof. FRANK H. BIGELOW.

V.—THE VARIABLE ACTION OF THE SUN AND ITS EFFECT UPON TERRESTRIAL WEATHER CONDITIONS.

APPLICATIONS TO THE PROBLEMS OF THE WEATHER.

The foregoing correlation of the connections between the phenomena of temperature, pressure, vapor tension, atmospheric electricity, ionization, and magnetic vectors seems to give a natural unity to these data which have been detached from one another in the previous scientific researches. The entire train of causes and effects is arranged by it in a satisfactory sequence, so that we are for the first time in a position to summarize the masses of evidence lying before us. It will be now possible, having a clear working hypothesis before us, to indicate the proper manner of continuing the investigations with every prospect of reaching a successful practical result. I propose in the remaining papers of this series to lay down a working program for American meteorologists to use, including in that term those astrophysicists who are interested in the sources of our radiant energy, as well as the climatologist and the forecaster who are concerned with the effects of radiation upon climatic and weather variations. The first paper will contain a popular statement of the general conditions; the second, a more technical account of the theoretical aspects of the problem of cosmical meteorology; and the third, a description of the organization of the Mount Weather Research Observatory which is designed to mediate between the theoretical and the practical sides of the subject.

THE SUN A VARIABLE STAR.

In order to bring out the underlying reason for believing that variable solar action is responsible, at least indirectly, for changes in the terrestrial weather from year to year, it is necessary to show in what way the sun is itself unequal in its internal movements. The sun is an immense solid-liquid mass, 866,000 miles in diameter, surrounded by a gaseous envelope which gradually changes to rarefied matter similar to that seen in vacuum tubes. Recent computations indicate that at the center of the sun there is a nucleus which instead of being gaseous is nearly as solid as the interior of the earth, with a temperature of about 10,000° centigrade; the average density of the whole sun is 1.43 times that of water, and this is located at half the distance from the center to the surface; the surface density is not far from 0.37 that of water, and its temperature, according to my calculation, ranges between 7000° and 6000° centigrade; at the surface there is a sudden transition from liquids to gases, which occurs as an explosion, caused by the uprush of liquids from the interior. The solar mass in such a physical state while rotating on its axis sets up a peculiar circulation, in consequence of which at the surface a huge wave is formed like a tide that advances most rapidly in the equatorial belt.

The body of the sun is divided up into layers of different temperatures, like a set of dice boxes inside one another, the longest axis extends through the sun from pole to pole, and these slide by one another at different velocities. This produces a stronger discharge of warm material in the polar regions than near the equator, so that on the sun the heat is greatest at the poles, reversing the conditions with which we are familiar in the earth's atmosphere.

The evidence for these facts is found in a study of the (1) sun spots, which occur in belts within 35° of the equator; (2) the faculæ or fleecy cloud-like forms found on all parts of the sun's surface, but most abundantly around the spots; (3) the prominences or gaseous flames projected in all latitudes above the disk; and (4) the coronas, which extend to great distances from the surface and somewhat resemble auroras in their nature.

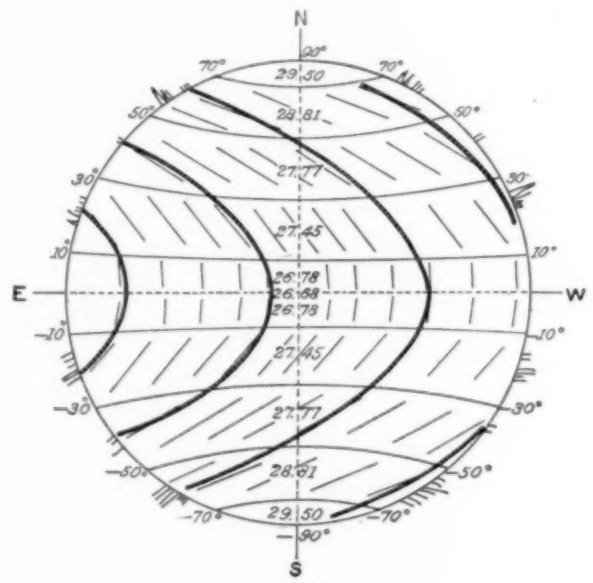

FIG. 64.

The visible surface is divided for convenience into successive zones beginning at the equator as shown on fig. 64, where the advancing equatorial wave is indicated, the time of rotation being marked in different latitudes with 26.68 days at the equator, increasing to 29.50 days at the poles. The time of the rotation of the internal solid nucleus is not known. There are some arguments for supposing it to be 26.00 days, and others for making it 26.68 days, but the subject has not yet yielded to study. The above periods of rotation are those seen from the earth as it passes around the sun in its orbit of 365 days.

Fig. 65 gives an excellent idea of the visible surface. This is mottled with cloud-like forms resembling the heads of cumulus clouds, and probably they represent the tops of columns of liquid or gaseous matter rising from the interior; there are three minute sun spots to be seen on it, and extensive regions of white calcium flocculi in the sun-spot belts. The spectroheliograph has developed the power to make pictures like this at different levels in the sun's atmosphere, representing sections through it, so that the action of the vapors and gases surrounding a spot can be studied at several elevations, just as we make out the cloud forms at different

levels in the earth's atmosphere by their types. In this picture the details are quite perfectly brought out.

Fig. 66 is an illustration of a great sun spot and the clouds or the flocculi in its neighborhood. Three or four such section pictures are made one over the other, wherein the forms change gradually from the lowest level to the highest. It is very probable that the true circulation in the region of the spots can be determined by examining the details of such pictures. The sun spots of the winter 1904–5 closely resemble the one in this illustration in size and appearance.

Fig. 67 gives some examples of quiescent and eruptive prominences or hydrogen flames, as observed at Kalocsa Observatory. The forms resemble flash illuminations in clouds during storms where no lightning discharge occurs, and are probably due to the light from the photosphere passing through rarefied layers of gas, in about the same way that the aurora illumination is formed. Electrical glow discharges and magnetic forces are probably in operation at the same time. The eruptive prominences are due to uprushes of gas exploding from the surface. The liquids in the interior are at very great pressure and temperature, but on reaching the surface this pressure diminishes suddenly and the liquid explodes into gaseous formations such as are shown. Enormous velocities up to 1000 miles per hour are indicated, and great altitudes up to 300,000 miles above the surface have been noted.

Beyond the limits of the gaseous constituents of the sun extends the corona which reaches altitudes of from 1,000,000 to 5,000,000 miles above the sun's surface. The lower section of fig. 68 gives four typical shapes, one at the minimum of solar activity, one at the maximum, one at the rising, and one at the falling phase. At the minimum the polar region is capped with a ray-like structure in which the streamers bend away to either side, as if they were the lines of force in a magnetic field surrounding a spheroidal magnet. At the maximum of the period the coronal forms are confused and no definite structure is preserved, indicating that some cause is operating to obscure the beautiful magnetic structure seen at the minimum when the sun is not very active. The corona of the sun can not be observed except during total eclipses, but it is found by comparing the forms secured during the past 40 years that it passes through a well defined cycle, repeated in about 11 years, as is indicated in the diagram. The next total eclipse will occur on August 29–30, 1905, and will be visible in Spain and northern Africa. Parties are already being formed in the United States to make observations on that occasion.

The passage from a quiet to a strongly agitated condition of the sun is marked also by other remarkable variations in phenomena which are visible from the earth. The upper section of fig. 68 gives the relative frequency of the sun-spot area as computed at the Greenwich Observatory. A minimum occurred in 1889, a maximum in 1894, and a second minimum in 1900, about 11 years later. The height of the shaded area is proportional to the number of sun spots seen on the sun, and it indicates that the rate of increase following the minimum is more rapid than the rate of decrease following the maximum. Similar curves of sun-spot frequency have been constructed for the last century, and in them it is found that there is considerable irregularity in the curve from one period to another, so that the 11-year period is merely an average of the range between 8 years and 14 years. On comparing the sun-spot curve with the changes in the magnetic and electric fields as observed on the earth, that is to say with the positions assumed by the magnetic needle and with the auroral displays in the polar regions, it is shown that these three systems are in very close accordance, and it is conceded that some relation of cause and effect prevails. The inference that the difference in the number of spots is the cause of the corresponding change in the earth's electricity or magnetism is not sustained by more minute examination of the details, except in a general way. The better theory is that the internal solar action produces all of these phenomena simultaneously, as the effects of an underlying cause which is not yet fully understood.

We can, perhaps, convey some idea of the present state of the investigation in the following way. The difficulty of the research has been due to the fact that the sun spots are only a sluggish register of the true solar action which causes the variable weather conditions, and it has been a great task to discover a better pulse. In 1894 the author published some results of a study of the meteorological conditions in the United States for the interval 1878–1893, in which it was found that the barometric pressure and the temperature vary slightly, not only in an 11-year period, but, also, in a 3-year period which is more clearly defined. In the same work it appeared that the average position of the storm tracks in the United States sways up and down in latitude, and also that the speed with which the storms drift eastward varies in the same short period. The annual magnetic field gives both periods in combination, the 3-year period superposed upon the 11-year period, thus making the inference probable that

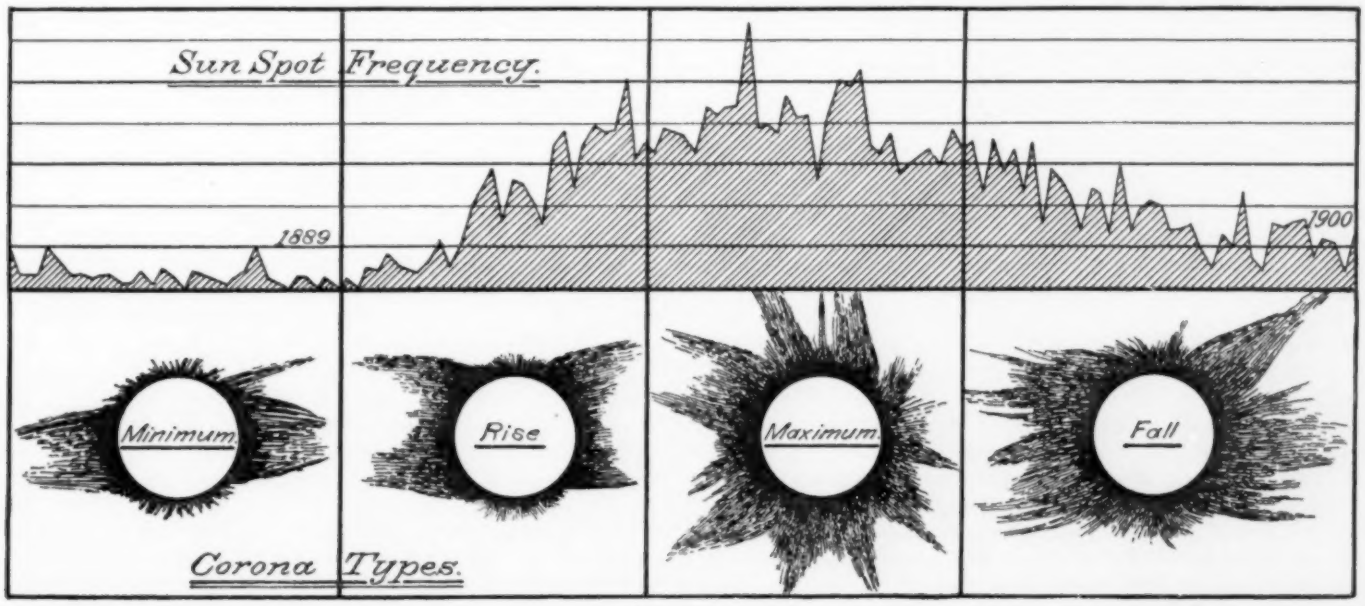

FIG. 68.

both periods in the meteorological and magnetic elements depend upon solar operations. Unfortunately the sun spots show us the 11-year period strongly and the 3-year period very feebly. This point has recently been cleared up by a study of the solar prominences, which have been continuously observed by the Italian spectroscopists since 1871.

Fig. 69 shows that great variations occur in the number of the prominences and the faculæ, the former being represented by the red marks on the diagram, and the latter by the blue marks. In the year of minimum activity, 1889, both prominences and faculæ are very few in number, but in the year of maximum activity, 1894, they are very abundant in the central zones, the prominences extending into the higher latitudes.

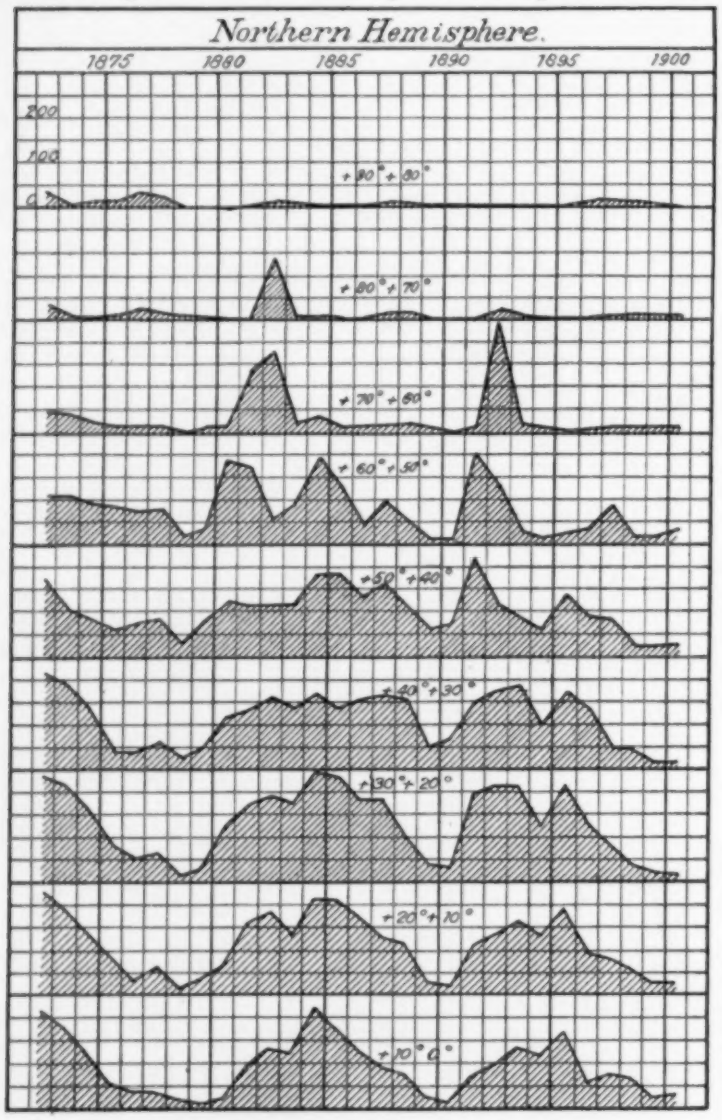

FIG. 70.

These eruptions on the surface of the sun move up and down the solar disk by a law of their own, and this must depend upon the internal energy of the sun, which, like a variable star, is passing through a series of periodic convulsions in its process of evolution. Lockyer, in 1902, published the result of his discussion of the prominences, as they occur in each 10-degree zone between the two poles of the sun. Thus, it is seen by fig. 70, for the Northern Hemisphere, how different the distribution of the prominences is in latitude. In the equatorial regions,[1] where the spots prevail, the 11-year period is very pronounced, though there are signs of the 3-year period in connection with it. On the other hand, in the higher latitudes,[2] the 11-year period diminishes in importance and the 3-year period supersedes it.

[1] Zones, (+ 10° 0°), (+ 20° + 10°), (+ 30° + 20°).

THE SYNCHRONOUS METEOROLOGICAL CONDITIONS ON THE EARTH.

Now, it happens that the frequency variation of the solar prominences in the higher latitudes gives the key that was wanted to enable us to study the meteorological conditions in the earth's atmosphere with some prospect of success. This variation shows that the meteorological pulse is registered most favorably not in the sun-spot belts, but in the zones of the sun corresponding with the temperate zones of the earth, from latitude 30° to 60°. In the polar zones in certain years the prominence frequency is very well marked, and these years correspond with the years of special activity in the earth's electric and magnetic fields.

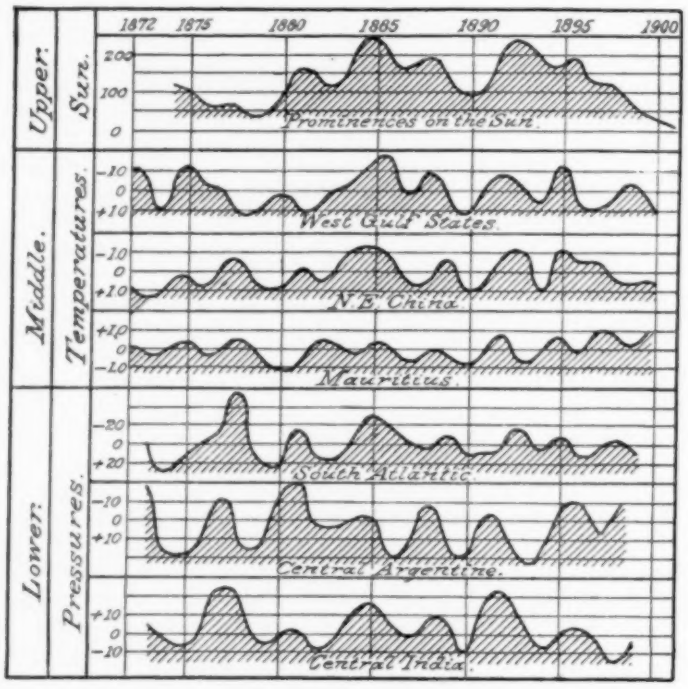

FIG. 71.

In order to extend the comparison of the solar-terrestrial conditions further, I computed the annual mean pressure and annual mean temperature for the series of years, 1872–1900, over many portions of the earth, comprising records for several hundred stations. They were grouped together by countries and a few of the curves are brought together in fig. 71. In the upper section of this figure the prominence frequency on the sun is averaged for all zones, and the resulting curve contains a 3-year period superposed upon the 11-year period. The middle section, marked "temperatures," contains temperature curves from the tropical and temperate zones, and it is easily seen, by comparing the crests with the solar curve at the top, that in spite of some irregularities there is a tendency to form the same number of crests and to make them fall on the same years as the crests in the prominences. The third section, marked "pressures," gives a few curves of the variations in the annual pressures and these conform quite closely to the same system. Each curve ought to be compared with the solar curve by itself, to judge of the general fact of agreement. It should, however, be observed that this agreement is not everywhere direct, but that in certain regions an inversion takes place. Thus, the pressures do not increase simultaneously all over the earth in one year and decrease in another year, rather there is a general surging by which the atmosphere is piled up in

[2] Zones, (+ 40° + 30°), (+ 50° + 40°), (+ 60° + 50°).

one region and lowered in another during the same year. This is necessary in order to avoid the difficulty of making the total weight of the earth's atmosphere vary from year to year. When the pressure is generally high in North or South America, it is low in Asia, the Indian Ocean, and Australia. This condition is brought about by some profound modification in the circulation of the earth's atmosphere, by which high areas tend to form in one hemisphere at the same time that low areas prevail in the opposite hemisphere. In a similar way the changes of temperature from year to year are such that in the tropical zones, where the sun shines fully on the earth's surface, temperatures rise and fall directly with the solar prominence frequency; but in the middle latitudes of the earth the opposite or reverse conditions of temperature prevail. Hence, when solar activity increases and more spots or prominences can be seen, there is an increase of heat in the earth's Tropics, and this produces an increase in the circulation of the entire atmosphere. The warm air of the Tropics rises more rapidly than usual, the cold air of the upper strata over the temperate zones pours down vigorously upon the United States, Europe, and Asia, and these countries are covered with a rapid succession of pronounced cold waves, such as have marked the years 1904 and 1905.

The increase in solar activity shows itself in yet another way. By putting together the tables of prominences so as to study their behavior in longitude, that is around the sun in the same zones, it has been found that the retardation of the solar rotation in the higher latitudes relative to the primary equatorial period of 26.68 days, sways backward and forward in harmony with the same prominence frequency curve. This indicates that the internal solar energy, in trying to free itself after accumulation and congestion, sends forth great waves, which rotate the circulation in the polar zones farther backward. The visible symptoms of this operation at the surface are changes in the number and location of the prominences, the faculæ, the sun spots, the granulation of the photosphere, and in the form and extent of the great coronal streamers. Besides this visible effect of the internal action, there is the more important and invisible radiation which streams from the sun and falls upon the earth.

Besides the general synchronism in the solar action just outlined, we have a corresponding movement in the earth's atmosphere embracing the magnetic and electrical forces, the pressure, temperature, vapor tension, and precipitation. Conflicting evidence will no doubt be reconciled by a more thorough study of the underlying facts of inversion, and generally the entire subject needs most careful investigation.

THE METEOROLOGICAL WORK OF THE U. S. NAVAL ECLIPSE EXPEDITION TO SPAIN AND ALGERIA, AUGUST 30, 1905.

By Prof. FRANK H. BIGELOW. Dated Daroca, Spain, August 27, 1905.

At the request of Rear-Admiral C. M. Chester, U. S. N., Commander in Chief of the Special Service Squadron *Minneapolis*, *Dixie*, and *Cæsar*, sent to observe the total eclipse of the sun, August 30, 1905, in Spain and north Africa, the Chief of the Weather Bureau detailed myself and Dr. Stanislav Hanzlik to carry out the meteorological observations required in this connection. Advantage was taken of the voyage on the *Cæsar*, which sailed from Norfolk on June 22, to make some kite ascensions with self-recording meteorographs for data over the ocean, and, also, to observe the electrical conditions near the water areas. We secured seven ascensions on the trip to Spain, and have made suitable preparations to continue the work on the return voyage in September. The southwest current prevailing on the western side of the Atlantic reached its maximum force about 1000 miles east of Norfolk, and the northeast current on the eastern side was at a maximum less than 500 miles from Spain. The former is much broader than the latter, and the wind did not reach a velocity as great on the western side as on the eastern side of the Atlantic. We found that there was no tendency to reversal of the temperature gradients such as Hergesell observed farther to the south in the trades, and we did not note any important diurnal variation of the temperature even at short distances above the surface of the ocean, though the kites were in the air as much as eight hours during several days. The electrical observations on the *Cæsar* include a few records of the potential gradient over the side of the ship, an excellent series of observations on the coefficient of dissipation with the Elster and Geitel apparatus, and a complete set for the number of ions per cubic centimeter with the Ebert apparatus, the velocity observations being omitted. All these electrical records were made in the calm region surrounding the Azores, lying between the two great currents just mentioned.

After landing at Gibraltar the expedition separated into two branches, Doctor Hanzlik in charge of the part in Algeria, and Professor Bigelow in charge of that in Spain. The African party sailed for Bona on July 19, and the astronomical and meteorological station was established at Guelma. It was planned to organize two secondary stations to supplement the work at Guelma, but these seem to have been abandoned for some reason. The Spanish parties landed at Valencia July 24, and the work of equipping the several stations proceeded regularly to a conclusion. On July 25 a meteorological station was arranged in the Institute of Castellon, Señor Josè Sanz Bremon, Director; on July 27 another station was planned at Tortosa, or rather the Director of the Cosmical Observatory of the Ebro, Rev. P. R. Cirera, S. J., agreed to furnish copies of the regular records as desired. The plan of this observatory is similar to that of the Mount Weather Research Observatory and contains a very excellent equipment of modern instruments and a corps of competent observers. As it is located within the belt of the eclipse shadow, it ought to give a fine account of itself, having such remarkable advantages for this occasion. On July 30–August 1 the work was organized at Porta Coeli, where the astronomical station No. 2, near the southern border of the track, was located. Besides the regular meteorological instruments, an Elster and Geitel apparatus and a potential electrometer were put in operation, and Messrs. Scrivener and Straupe being left in charge. This station has been in operation for fully four weeks, a portion of the time day and night, and a very extensive series of observations is in hand.

On August 3–6 another station was installed at Daroca in connection with the astronomical station No. 1, near the center of the belt. In addition to the instruments mentioned at Porta Coeli, an Ebert apparatus for the number and velocity of the ions, a Brashear polarimeter, and a solar image telescope were set up. It was intended to execute a series of radiation observations with a mercury actinometer, but the copper box as originally made failed and it was not possible to secure a new one till too late to make that work profitable. The magnetic observations were inadequately organized at this station and will not be important in this connection. All the instruments at Daroca have been in constant use by myself aided by Messrs. Rickerd, Trainor, and Olivier, and we have obtained several thousand observations, some of the electrical series continuing uninterruptedly day and night for more than a week. From Daroca I proceeded to Zaragoza and arranged for suitable observations at the Colegio del Salvador in charge of Rev. Josè Albiñana, S. J., August 8; then to Guadalajara, where similar observations will be furnished by Lieut. Col. Pedro Vives y Vich, chief of the Spanish aerostatic service, who, also, has charge of all the balloon ascensions at Burgos undertaken by the International Committee during this eclipse. The homing pigeon service and the balloon equipment at Guadalajara were very interesting and instructive.

A brief visit to Madrid for supplies, and to see the Astronomical Observatory, followed, and finally I returned to Daroca August 13. Observations will be continued regularly till the day following the eclipse, August 31, when the various pieces of apparatus will be gradually collected from the several places and put aboard the *Cæsar*, which will sail from Nice on September 13 for the United States.

The climate in Spain has proved to be unexpectedly agreeable and favorable for such an eclipse expedition as this. The air is generally dry and for the most part cloudless; there have been no thunderstorms and no rains for weeks; the temperature at Daroca, 2200 feet above the sea, reaches about 90° F. at midday, but falls to 50° or 60° every night. The extreme heat was 95° on two days, and the lowest night temperature 42°. It should be noted that in the daytime the relative humidity falls to about 40 per cent on the average, but on the hottest days to 25 or 30 per cent, while at night it rises to above 90 per cent, often to 96 per cent. This wide range of temperature and relative humidity is accompanied by a remarkably steady barometer, ranging about two-tenths of an inch per day, and only four-tenths of an inch during several weeks. The cyclonic system that prevails in the United States does not seem to exist in Spain in the summer. On the sea coast the sea breeze is especially vigorous, so that the stations Porta Coeli, Castellon, and Tortosa will record that feature fully in connection with the eclipse, while the inland stations Daroca, Zaragoza, and Guadalajara, will be free from it. This will enable us to study the so-called "eclipse cyclone" with data bearing directly upon the subject. The circulars containing instructions regarding the shadow bands have been distributed very widely and there is an apparent interest in this subject.

The Spanish people have been most hospitable toward the American eclipse parties, and indeed to all the visiting scientists, of whom there are now many in Spain, and they have always most cordially assisted in carrying out the plans proposed for the benefit of the expeditions. We shall always recall their hospitality with feelings of gratitude and obligation.

DAROCA, SPAIN, *August 30, 1905.*

The total eclipse was an entire success at this station so far as the weather was concerned. The 29th had been a very anxious day, because it was heavily clouded, with occasional showers, for the first time in four weeks, but the wind shifted from west to north toward evening, the temperature dropped to 40° during the night and the morning of the 30th was fair. There were numerous cumulus and alto-cumulus clouds, but they gradually dissipated by noon, and at 1 p. m. the region around the sun was exceptionally clear. The sky polarization was 58 per cent during the eclipse, and while we have had occasional readings of 72 per cent, this means an atmosphere quite clear of uncondensed vapor. The barometer remained unaffected, the temperature dropped 8° F. in the shade and 18° in the sunshine. The wind was very light and there seemed to be no special change during the middle hour of the eclipse. The shadow bands were very feeble and disappointing, but they were seen for 40 seconds ending within 15 seconds of the second contact, and again less distinctly for a half a minute from about 30 seconds after the third contact. Their direction of motion was along the central line and they lay exactly perpendicular to it; their width was such as to give about two bands and three spaces to the foot; the velocity was about three feet per second. The electrical observations were carried on without interruption from 6 a. m. till 8 p. m., but the results can not be stated without computation. The corona as seen through the opera glass and in my 3.5-inch telescope was a beautiful sight, as usual, typical of the corona at the maximum of the sun-spot period. Two common sized spots and three smaller ones were present, and the times of contacts I and IV and the passage of the limb of the moon over these spots were noted at least approximately. The rays of the corona were generally radial, the polar curved rays being obscure and irregular. There were several stellar points on the streamers, which extended generally two diameters from the sun. There were no very extensive streamers, but the corona was bright and rather condensed, of a steel gray, pearly color, as seen in some electrical phenomena; the inner corona was brilliant and there were two long groups of superb rosy-tinted prominences which will become famous in the history of solar eclipses. The work with the spectroscopes and cameras at Daroca is believed to have been of the best quality, but it is not known at this time what special information was secured. The health of the entire party of twenty persons has been excellent.

OBSERVATIONS OF EARTH TEMPERATURE IN JAPAN.[1]

By Dr. S. TETSU TAMURA. Dated Washington, D. C., June 10, 1905.

(1) INTRODUCTION.

The earth's crust and the outer soil furnish examples of the periodic flow of heat that illustrate Fourier's beautiful theorem. If the earth's surface be heated and cooled periodically, a thermometer sunk in the ground will exhibit corresponding variations of temperature. By day the surface of the earth is heated, a diurnal temperature wave is propagated into the interior and the indication of the thermometer gradually rises. As the earth's surface is cooled at night, the thermometer will exhibit a fall of temperature. If, therefore, the surface temperature is a periodic function of the time, then the temperature at any depth will vary in a corresponding periodic manner. When the periodic variation has been maintained for a sufficient time, the oscillations of temperature, at any depth, will attain a fixed character so that the mean temperature at each point remains steady. There are also annual temperature waves due to heating during summer and cooling during winter, and irregular oscillations, due to cloudiness, rainfall, snow on ground, etc.

If θ is the temperature of the soil at any depth x, t the time, and a^2 the diffusivity[2] of the soil, we have the equation:

$$\frac{\partial \theta}{\partial t} = a^2 \frac{\partial^2 \theta}{\partial x^2}. \qquad (1)$$

If θ is a periodic function of the time t, or $\theta = F(t)$ for the earth's surface $x = 0$, we can integrate the above equation readily. As the equation (1) is linear with a constant coefficient we get a particular solution by the following device used in articles 7 and 8 of Byerly's, Fourier's Series and Spherical Harmonics. Let $\theta = e^{\beta t + \alpha x}$

and substitute this in (1): we obtain $\beta = a^2 \alpha^2$

whence $$\theta = e^{\beta t \pm \frac{x}{a}\sqrt{\beta}} \qquad (2)$$

which is a solution of equation (1) no matter what value is given to β.

In order to put this into a more convenient trigonometric form, replace β by $\pm \beta i$ and equation (2) becomes

[1] More than a year ago Doctor Tamura consented to give us some account of work done by Japanese meteorologists, which promise, however, could not be fulfilled until to-day, on account of the pressure of his other work. The paper here given is a review of memoirs on the earth-temperature observations by his compatriots, Doctors Nakamura, Oishi, and Okada. Doctor Tamura has added, as an explanation, a note on the mathematical principle of the problems of earth temperature that will facilitate the reading by those who are not familiar with the subject.—[ED.]

[2] The diffusivity of the soil $a^2 = \frac{k}{\rho c}$ where k = the conductivity of the soil, ρ its density, and c its specific heat. These four quantities are assumed constant in the mathematical analysis, but actually they vary with the water in the soil and also with the distance below the surface.

$$\theta = e^{\pm \beta t i \pm \frac{x}{a}\sqrt{\beta}\sqrt{\pm i}}$$

whence, by the relations

$$\sqrt{i} = \pm \frac{1}{2}\sqrt{2}\,(1+i)$$

$$\sqrt{-i} = \pm \frac{1}{2}\sqrt{2}\,(1-i)$$

we get

$$\theta = e^{\pm \beta t i \pm \frac{x}{a}(1\pm i)\sqrt{\beta/2}}$$

or

$$\theta = e^{\left(\beta t - \frac{x}{a}\right)i}\, e^{-\frac{x}{a}\sqrt{\beta/2}} \tag{3}$$

and

$$\theta = e^{-\left(\beta t - \frac{x}{a}\right)i}\, e^{-\frac{x}{a}\sqrt{\beta/2}}. \tag{4}$$

By adding these values of θ and dividing by 2, we have [3]

$$\theta = e^{-\frac{x}{a}\sqrt{\beta/2}} \cos\left(\beta t - \frac{x}{a}\sqrt{\beta/2}\right) \tag{5}$$

By subtracting (3) from (4) and dividing by $2i$, we obtain

$$\theta = e^{-\frac{x}{a}\sqrt{\beta/2}} \sin\left(\beta t - \frac{x}{a}\sqrt{\beta/2}\right) \tag{6}$$

In similar manner we can build up the expressions

$$\theta = e^{+\frac{x}{a}\sqrt{\beta/2}} \cos\left(\beta t + \frac{x}{a}\sqrt{\beta/2}\right) \tag{7}$$

$$\theta = e^{+\frac{x}{a}\sqrt{\beta/2}} \sin\left(\beta t + \frac{x}{a}\sqrt{\beta/2}\right) \tag{8}$$

All these expressions (3)–(8) are particular solutions of equation (1); but (7) and (8) do not satisfy our fundamental condition, for according to them θ becomes greater as x is greater. Equations (5) and (6) become more general by introducing certain constants, A, q, and C; these do not vary with time, but only with depth, and we can write the equations as follows:

$$\theta = A e^{-\frac{x}{a}\sqrt{\beta/2}} \sin\left(\beta t - \frac{x}{a}\sqrt{\frac{\beta}{2}} + q\right) + C \tag{9}$$

$$\theta = A e^{-\frac{x}{a}\sqrt{\beta/2}} \cos\left(\beta t - \frac{x}{a}\sqrt{\frac{\beta}{2}} + q\right) + C. \tag{10}$$

We can build up from equation (9) a general solution,

$$\theta = \sum_{n=1}^{n=\infty} A_n e^{-\frac{x}{a}\sqrt{n\omega/2}} \sin\left(n\omega t - \frac{x}{a}\sqrt{\frac{n\omega}{2}} + q_n\right). \tag{11}$$

and a similar cosine series from (10), where n is any positive whole number from one to infinity.

It is clear that if we confine our attention to a definite point of the soil, so that x remains constant while t varies, then θ will vary periodically, returning to the same value when t is increased by any multiple of $\frac{2\pi}{\beta}$.

Hence, if it be assumed that the earth's surface is subjected to a simple harmonic change of temperature, and that the complete period of a heating and cooling is T, we have

$$\frac{2\pi}{\beta} = T$$

or

$$\beta = \frac{2\pi}{T} \tag{12}$$

and consequently β measures the rapidity of the alternation of temperature. Then (9) becomes

$$\theta = A e^{-\frac{x}{a}\sqrt{\pi/T}} \sin\left(\frac{2\pi}{T}t - \frac{x}{a}\sqrt{\frac{\pi}{T}} + q\right) + C. \tag{13}$$

[3] Byerly's Integral Calculus, article 35. Fourier's Series and Spherical Harmonics, articles 49 and 52.

Let us examine the time at which a thermometer placed in the soil at a depth, x, below the earth's surface will reach its highest or lowest temperature. This will happen when

$$\sin\left(\frac{2\pi}{T}t - \frac{x}{a}\sqrt{\frac{\pi}{T}} + q\right)$$

attains its greatest or least value, that is, when the angle is $\frac{\pi}{2}$, $\frac{3\pi}{2}$, $\frac{5\pi}{2}$, etc., or when the sine is ± 1; or, in other words, the temperature will be maximum at the depth x_1 at the time t_1 given by the equation

$$\frac{2\pi}{T}t_1 - \frac{x_1}{a}\sqrt{\frac{\pi}{T}} + q = \left(2n + \frac{1}{2}\right)\pi$$

where n is any whole number. The maximum temperature at a depth x_2 will be reached at a time t_2 given by the equation

$$\frac{2\pi}{T}t_2 - \frac{x_2}{a}\sqrt{\frac{\pi}{T}} + q = \left(2n + \frac{1}{2}\right)\pi.$$

The minimum temperatures at the same points will be reached when the values are $\left(2n - \frac{1}{2}\right)\pi$.

By subtracting the equations for t_1 and t_2 we get

$$\frac{2\pi}{T}(t_1 - t_2) - \frac{1}{a}(x_1 - x_2)\sqrt{\frac{\pi}{T}} = 0 \tag{14}$$

or

$$\frac{x_2 - x_1}{t_2 - t_1} = 2a\sqrt{\frac{\pi}{T}}. \tag{15}$$

A similar analytical formula can be obtained for the minimum temperatures, and we see that the time at which the maximum or minimum temperature arrives at any depth is later in simple proportion as the depth is greater.

If the points x_1 and x_2 be so chosen that successive maxima or minima occur at them simultaneously, we shall have $t_2 - t_1$ equal to the periodic time T, and the difference $x_2 - x_1$ will be equal to the length of a temperature wave λ, and equation (14) gives

$$2\pi - \frac{1}{a}\lambda\sqrt{\frac{\pi}{T}} = 0$$

or

$$a^2 = \frac{\lambda^2}{4\pi T}. \tag{16}$$

In order to determine the diffusivity of the soil it is consequently necessary to measure the wave length λ corresponding to one simple harmonic variation of the known period T, and the conductivity may then be calculated from it. Equation (16) may be written

$$a^2 = \frac{1}{4\pi}\lambda v \tag{17}$$

where v is the velocity of propagation of the temperature wave $\frac{\lambda}{T}$. Hence, the diffusivity is jointly proportional to the wave length and to the velocity of propagation. Again the expression (16) may be written in the forms

$$\lambda^2 = 4a^2\pi T$$

$$\frac{\lambda^2}{T^2} = 4a^2\frac{\pi}{T}$$

$$\frac{\lambda}{T} = 2a\sqrt{\frac{\pi}{T}}$$

whence

$$v = 2a\sqrt{\frac{\pi}{T}} \tag{18}$$

which is also derivable from (15) directly.

The velocity of propagation of the temperature wave is directly proportional to the square root of the diffusivity, and inversely as the square root of the period.

Now let us determine the values of the constants A and C in the expression (13). As previously mentioned θ attains its maximum when $\sin\left(\frac{2\pi}{T}t - \frac{x}{a}\sqrt{\frac{\pi}{T}} + q\right)$ is equal to + 1 and its minimum when this sine is equal to —1. Therefore, for the depth x

$$\left.\begin{aligned}\theta_{max} &= +Ae^{-\frac{x}{a}\sqrt{\pi/T}} + C\\ \theta_{min} &= -Ae^{-\frac{x}{a}\sqrt{\pi/T}} + C\end{aligned}\right\} \quad (19)$$

whence $$C = \frac{\theta_{max} + \theta_{min}}{2} = \theta_m$$

where θ_m is the mean temperature at the depth x. At the surface $x = 0$ and equation (19) becomes

$$\theta_{max} = +A + C$$
$$\theta_{min} = -A + C$$

whence $$A = \frac{\theta_{max} - \theta_{min}}{2} = a_0$$

where a_0 is the amplitude of the temperature variation at the earth's surface. Hence, our equation (13) may be put into the form,

$$\theta = \theta_m + a_0 e^{-\frac{x}{a}\sqrt{\pi/T}} \sin\left(\frac{2\pi}{T}t - \frac{x}{a}\sqrt{\frac{\pi}{T}} + q\right)$$

or from (16)

$$\theta = \theta_m + a_0 e^{-\frac{2\pi x}{\lambda}} \sin\left(\frac{2\pi}{T}t - \frac{x}{\lambda} + \frac{q}{2\pi}\right). \quad (20)$$

Thus, the amplitude of the temperature variation at any depth x is jointly proportional to $e^{-\frac{x}{a}\sqrt{\pi/T}}$ or $e^{-\frac{2\pi x}{\lambda}}$ and to the amplitude a_0 of the surface temperature. Or

$$a = a_0 e^{-\frac{x}{a}\sqrt{\pi/T}} = a_0 e^{-\frac{2\pi x}{\lambda}} \quad (21)$$

$$\log a = \log a_0 - \frac{x}{a}\sqrt{\frac{\pi}{T}} = \log a_0 - \frac{2\pi x}{\lambda} \quad (22)$$

so that the amplitudes go on decreasing as the heat penetrates downward from the earth's surface; the amplitudes diminish more slowly with depth if the conductivity be higher or if the period be longer, and more quickly if the thermal capacity of the earth be greater. At a certain stratum the amplitudes finally become inappreciable (although they do not vanish except at infinity) and this is called the stratum of invariable temperature. The depth of this stratum may be calculated from the formula (23) as derived from equation (22)

$$x = \frac{\log a_0 - \log a_\lambda}{2\pi} \quad (23)$$

It will be easily seen that the mean temperature θ_m at all depths will not be the same, but will diminish as we go downward from the earth's surface, the curve of mean temperature being logarithmic. The variation of earth temperature at any depth may be represented by a curve, such as fig. 1, which is obtained by plotting the harmonic equation (20), taking x as constant and t as variable. The temperature variations at the various depths at any moment may be represented by a curve, such as fig, 2, which is obtained by plotting the same equation, taking x as variable but t as constant.

A glance at any table of the observed variation of earth temperature will show that the variation is by no means of the simple harmonic character that we have assumed in the above formulæ. There are many sources of disturbance, e. g., the irregularity of the variations of the atmospheric temperature and of surface temperature, heterogeneity of the soil, changes in the cloudiness, the unequal water percolation, etc. If, however, the surface temperature varies to and fro in any

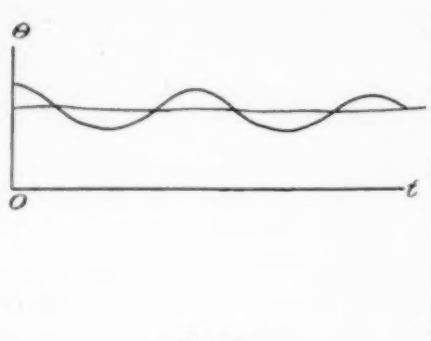

FIG. 1.

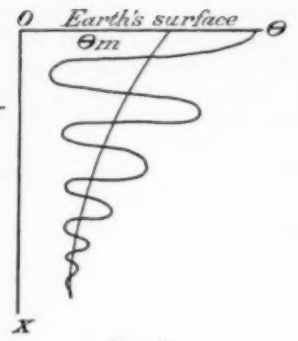

FIG. 2.

manner, it may be expressed by a complex harmonic function, such as

$$\theta = \theta_m + \sum_{n=1}^{n=\infty} A_n e^{-\frac{x}{a}\sqrt{n\pi/T}} \sin\left(\frac{2\pi}{T}nt - \frac{x}{a}\sqrt{\frac{n\pi}{T}} + q_n\right) \quad (24)$$

which is a general solution of (1), built up of all particular sine solutions, or in more popular form

$$\theta = \theta_m + A_1 e^{-p_1 x}\sin\left(\frac{2\pi}{T}t - p_1 x + q_1\right) + A_2 e^{-p_2 x}\sin\left(\frac{2\pi}{T}2t - p_2 x + q_2\right) + \text{etc.} \quad (25)$$

This is equivalent to the following so-called Bessel's interpolation formula:

$$\theta = \theta_m + a_1\sin\left(\frac{2\pi}{T}t + \varphi_1\right) + a_2\sin\left(\frac{2\pi}{T}2t + \varphi_2\right) + a_3\sin\left(\frac{2\pi}{T}3t + \varphi_3\right) + \text{etc.}, \quad (26)$$

which represents the temperature at any time and at any depth; the amplitudes a_1, a_2, a_3, etc., and the phases φ_1, φ_2, φ_3, etc., for any depth may be determined from observational data by means of the method of least squares.

Now the comparison of (22), (23), and (24) offers us the following important relations:

$$\text{Amplitudes}\left\{\begin{aligned}a_1 &= A_1 e^{-p_1 x}\\ a_2 &= A_2 e^{-p_2 x}\\ a_3 &= A_3 e^{-p_3 x}\end{aligned}\right\} \quad (27)$$
etc.

$$\text{Phases}\left\{\begin{aligned}\varphi_1 &= q_1 - p_1 x\\ \varphi_2 &= q_2 - p_2 x\\ \varphi_3 &= q_3 - p_3 x\end{aligned}\right\} \quad (28)$$
etc.

$$\left.\begin{aligned}p_1 &= \sqrt{\frac{\pi}{a^2 T}}\\ p_2 &= \sqrt{\frac{2\pi}{a^2 T}}\\ p_3 &= \sqrt{\frac{3\pi}{a^2 T}}\end{aligned}\right\} \text{ or } \left\{\begin{aligned}a^2 &= \frac{\pi}{p_1^2 T}\\ a^2 &= \frac{2\pi}{p_2^2 T}\\ a^2 &= \frac{3\pi}{p_3^2 T}\end{aligned}\right\} \quad (29)$$
etc.

The diffusivity a^2 of the soil may be calculated in two different ways: The formulæ (27) for the logarithmic decrement of amplitudes, together with the formula (29), give a set of the values of a^2, since the amplitudes a_1, a_2, etc., are given by observations. Another set of the values of a^2 may be obtained by means of the formula (28) for the phase difference, together with the formula (29), since φ_1, φ_2, φ_3, etc., are given by observations, and q_1, q_2, q_3, etc., are phases at the earth's surface.

All the two sets of values of a^2 for any depth would agree perfectly if the data were accurate, and the natural conditions agreed with our hypotheses, e. g., when the soil is homogeneous and possesses uniform specific heat, and when the

isothermal surfaces are parallel planes. As these conditions, however, are not fulfilled, the first thing to find out is how far the different determinations agree and learn accordingly how far the theory may be applied.

(2) PROF. NAKAMURA'S DISCUSSION OF OBSERVATIONS AT TOKYO.

The problem of the variation of the soil temperature has attracted the attention of Japanese meteorologists and all the meteorological stations of the first order are now equipped with earth thermometers. The first paper on the subject that has come to my notice is one published in Japanese in the Journal of the Tokyo Physico-Chemical Institute, in 1893, by Prof. K. Nakamura, now director of the Central Meteorological Observatory of Japan. His discussion is based on the observations taken at Tokyo during the three years 1889–1892 at the observatory whose geographical coordinates are:

Latitude = 35° 41′ north.

Longitude = 139° 45′ east.

Altitude = 20 meters above sea level.

The earth thermometers were placed at the depths 0.0, 0.3, 0.6, 1.2, 3.0, 5.0, and 7.0 meters. From the tables given by Doctor Nakamura the following results of observations have been copied as regards the times of the occurrence of the annual maximum and minimum temperatures at various depths.

TABLE 1.

Depth, in meters.	Epoch of occurrence of —	
	Maximum.	Minimum.
0.0	August (II)	January (III)
0.3	August (III)	February (I)
0.6	August (III)	February (II)
1.2	September (II)	March (I)
3.0	November (II)	May (I)
5.0	January (III)	August (I)
7.0	April (II)	October (II)

NOTE.—I indicates the first, II the second, and III the third decade of the month.

It will be seen that the maximum and minimum temperatures occur on the earth's surface in August and January, respectively, but at a depth of five meters they occur in January and August, respectively, or one-half year behind.

Next Doctor Nakamura analyzed his observational data by the formula (26), taking the first three terms only and computed the values of the amplitudes a_1, a_2, a_3, and the phases φ_1, φ_2, φ_3, as in Table 2.

TABLE 2.

Depth in meters.	Mean temperature.	Amplitudes.			Phases.		
	θ_m	a_1	a_2	a_3	ϕ_1	ϕ_2	ϕ_3
	°C.	°C.	°C.	°C.	°	°	°
0.0	15.8	12.64	1.54	0.50	247.9	301.1	137.7
0.3	16.3	10.31	1.04	0.29	237.9	281.9	107.3
0.6	16.0	9.02	0.82	0.31	228.8	273.1	81.0
1.2	16.4	6.53	0.51	0.19	208.4	245.6	15.2
3.0	15.7	2.64	0.19	0.11	147.5	160.5	259.5
5.0	15.5	0.70	0.01	0.02	63.1	222.2	120.3
7.0	15.3	0.22	0.02	0.01	357.6	259.9	83.7

The author then computed the temperatures for each portion of a year by means of these constants, and found that the observational and computed values agree quite closely. Next substituting the values of a and φ, from Table 2, in the formulæ (27) and (28), Nakamura determined the values of the constants A, p, and q from which he formed the following equations:

$$a_1 = 12.856\, e^{-0.00573\, x}$$
$$a_2 = \ldots\ldots$$
$$\varphi_1 = 250.2° - 0.363°\, x$$
$$\varphi_2 = 302.0° - 0.520°\, x$$
$$\text{etc.}$$

With these equations he again computed the values of a and φ for different depths which agree well with those in Table 2, though we find that the discrepancies are rather greater in the case of a_2, a_3, and φ_3.

Finally the author computed the values of a^2. According to his computation

$$p_1 = 0.00573$$
$$p_2 = 0.00907$$

whence by equation (29) we have (in C. G. S. units) from p_1

$$a^2 = 0.00246$$

and from p_2

$$a^2 = 0.00263$$

the mean of which is

$$a^2 = 0.00250$$

(3) DOCTOR OISHI'S DISCUSSION OF OBSERVATIONS AT TOKYO.

The second paper[4] on earth temperature at Tokyo was published in 1904 by Dr. W. Oishi, Meteorologist of the Central Meteorological Observatory. This discussion is based on the observations of more than fifteen years, (1886-1902). The earth thermometers were planted in an open, flat field whose soil consisted of loam, its surface being covered with short grass. The depths and other data are given in Table 3.

TABLE 3.

Depths below surface.	Thermometers used.	Number of observations.
Meters.		
(1) 0.0	Ordinary mercurial thermometer laid on the ground, with its bulb covered with soil.	Hourly.
(2) 0.05 (3) 0.1 (4) 0.2	Bulbs buried at respective depths and stems exposed in the shade.	6 times daily.
(5) 0.3 (6) 0.6 (7) 1.2 (8) 3.0	Slow-acting thermometers, suspended by chains in iron tubes, 2.7 centimeters in diameter; sealed at lower ends and closed above the ground with copper cups.	Twice daily, 10 a.m. and 10 p.m.
(9) 5.0 (10) 7.0		Once a day, at 10 a.m.

Doctor Oishi discusses the diurnal, annual, and secular variations of earth temperature and gives tables of the temperatures of the air, the surface, and the earth. Comparing the values of air temperature at 1.2 meters above the ground with the temperature of the earth's surface, the author says that the monthly mean surface temperature is generally higher than the air temperature, and in summer the difference is very remarkable; in winter the difference is less and the surface temperature is lower. Oishi thinks it very strange that the surface temperature is lower than the air temperature during daytime in winter, while it is expected to be higher in ordinary cases. For the explanation of these facts he mentioned that the surface was protected from sun's heat by short grass, and, moreover, it was moist and there was much evaporation from it. While the daily maximum of air temperature occurs at 2 p. m. through the whole year, that of the surface temperature takes place at 1 p. m., except in winter, during which it occurs at 2 p. m. The daily minima of surface and air temperatures both occur at 5 a. m. in summer and 7 a. m. in winter.

The comparison of the surface and the deeper earth temperatures shows that the diurnal variation is remarkable on the surface, but it steadily diminishes with increasing depth, and the times of occurrence of maxima and minima are gradually retarded as anticipated in the mathematical theory. For example, the author shows that in January the temperature range amounts to 6.8° C. on the surface, while it is reduced to 0.1° at the depth of 0.3 meter; in July it is 11.4° on the surface, but 0.2° at that same depth. The daily maximum temperature of January occurs at 2 p. m. on the surface, while at 0.3 meter

[4] The Bulletin of the Central Meteorological Observatory of Japan, No. 1.

it is retarded to 2 a. m. of the next day. In July, the surface maximum temperature is observed at 1 p. m., while the maximum at 6.3 meters occurs at 10 a. m. Minimum temperatures of January occur at 7 a. m. on the surface and at 6 p. m. at a depth of 0.3 meter, and those of July take place at 5 a. m. and noon, respectively.

Doctor Oishi then furnishes us a very important table of 5-day means of earth temperatures for the year. As in the case of daily temperature range, so also the annual range decreases rapidly under the ground, and the times of occurrence of maximum and minimum temperatures are retarded gradually.

TABLE 4.

Depth, in meters.	Annual range.	Time of occurrence.	
		Max.	Min.
	°		
0.0	28.2	Aug. 11	Jan. 23
0.3	22.7	Aug. 16	Jan. 23
0.6	18.7	Aug. 21	Jan. 31
1.2	14.0	Sept. 15	Feb. 27
3.0	5.2	Nov. 6	May 5
5.0	1.3	Feb. 2	July 30
7.0	0.4	April 30	Oct. 30

The author now applies to the 5-day means of the earth temperatures the formula (26) as far as the fourth term. By means of the method of least squares he determined the coefficients a_1, a_2, a_3, a_4 and φ_1, φ_2, φ_3, φ_4, for each depth separately as given in Table 5.

TABLE 5.

Depth, in meters.	θ_m	a_1	a_2	a_3	a_4	ϕ_1	ϕ_2	ϕ_3	ϕ_4
	°C.	°C.	°C.	°C.	°C.	°	°	°	°
0.0	15.629	12.931	1.185	0.641	0.485	244.55	298.05	136.26	290.79
0.3	15.713	10.738	0.863	0.543	0.313	235.76	284.08	133.13	228.84
0.6	15.693	9.051	0.692	0.403	0.209	225.47	279.82	69.49	270.54
1.2	15.958	6.696	0.383	0.197	0.056	206.03	261.89	32.96	271.02
3.0	15.779	2.514	0.112	0.085	0.025	142.77	174.34	291.43	43.35
5.0	15.499	0.640	0.011	0.004	0.007	59.07	142.13	104.04	60.26
7.0	15.390	0.192	0.009	0.008	0.002	341.19	200.56	345.96	63.44

As did Nakamura so also Oishi substituted these values for the constants of the formula (26) and computed the values of θ for each epoch and each depth; the computed values agree reasonably with the observed data.

The most important feature of the present paper is perhaps the two independent computations of the values of the soil diffusivity. According to Oishi the values of a^2_a, calculated from amplitudes and a^2_ϕ from phase differences are as in Table 6.

TABLE 6.—*Coefficients of temperature diffusivity of the soil at different depths in C. G. S. units.*

Depth, in meters.	a^2_a	a^2_ϕ	$\frac{1}{2}(a^2_a + a^2_\phi)$
0.0—0.3	0.00259	0.00381	0.00320
0.3—0.6	0.00307	0.00278	0.00293
0.6—1.2	0.00395	0.00311	0.00353
1.2—3.0	0.00336	0.00265	0.00301
3.0—5.0	0.00213	0.00186	0.00200
5.0—7.0	0.00275	0.00216	0.00246
Average..	0.00298	0.00273	0.00286

The author shows how closely these values agree with those calculated from the equation for amplitudes, and from the equation for phase differences, by finding the constants only for the first term, a_1, p_1, and q_1.

$$a^2_a = 0.00276$$
$$a^2_\phi = 0.00230$$
$$\tfrac{1}{2}(a^2_a + a^2_\phi) = 0.00253$$

This value holds, of course, in the case of simple harmonic variation of temperature only. From the amplitude equation

$$a_z = 13.347\, e^{-0.006009\, z}$$

the annual temperature range at Tokyo is shown to reduce to 0.2° C. at the depth of 8 meters and to 0.01° C. at 13 meters. Thus, a great difference is observed in the depths at which the annual and diurnal ranges are respectively reduced to a given fraction of the same range at the surface. Theoretically the depths are as the square roots of the periods; i. e., as $\sqrt{365.24}$ to 1, or nearly 19 to 1. The author concludes that this fairly agrees with the results of observations.

Finally, Oishi gives an interesting account of the secular variations of the temperatures of the air and earth. According to a table prepared by him the secular changes of temperature observed in the air are noticed under ground, and generally in the same year down to a depth of 1.2 meters, but in the following year at the strata from 3 to 7 meters below the surface. Thus, the maximum temperature (14.77° C.) in the air in 1894 was observed also down to the depth of 1.2 meters in the same year, and at the depths of 3, 5, and 7 meters in the same year. The maximum temperature of 1898 was observed at 0.3 meter below in the same year; at the depths 0.6 to 5 meters, in the following year; and at the depth of 7 meters in 1900. The minimum temperature in 1897 occurred at the depth of 1.2 meters in the same year, at the depths 3 to 5 meters in the following year, and 7 meters in 1898 and 1899.

OKADA'S DISCUSSION OF THE OBSERVATIONS AT NAGOYA.

Dr. T. Okada, of the Central Meteorological Observatory, has published two papers on this subject, with the titles, "On the Underground Temperature Observations made at Nagoya, Japan,"[5] and "Discussion of the Earth Temperature Observations made at Osaka Meteorological Observatory."[6] The data for the first paper consist of the record of ten years' observations (1894-1903) at Nagoya Meteorological Observatory, which is situated in 35° 10′ north and 136° 55′ east, and lies fifteen meters above sea level. The soil in which the observations were made consists of a mixture of sand and loam, and the surface is covered with sod. The temperatures were observed at the depths of 0.0, 0.3, 1.5, 3.0, 6.0, and 12.0 meters. The instruments and methods employed were about the same as those described by Oishi.

According to Okada's table, the mean temperature of the earth's surface is higher than that of the air throughout the year. The difference is greatest in August and least in January, and is about 2° in the annual mean. The epochs of occurrences of the extreme temperatures are gradually retarded with increasing depth, as shown in Table 7, but do not quite agree with those observed by Doctors Nakamura and Oishi at Tokyo.

TABLE 7.

Depth, in meters.	Annual range.	Time of occurrence.	
		Max.	Min.
	°C.		
0.0	25.5	August.	January.
3.0	8.3	October.	April.
6.0	2.0	December.	June.

The constants of the harmonic formula (26) as computed by Okada are as in Table 8.

TABLE 8.

Depth, in meters.	θ	a_1	a_2	a_3	ϕ_1	ϕ_2	ϕ_3
	°C.	°C.	°C.	°C.	°	°	°
0.0	16.56	12.42	1.06	0.60	244.1	307.2	116.1
0.3	16.50	10.46	0.88	0.43	235.2	290.9	111.1
1.5	16.47	6.59	0.40	0.17	198.7	280.3	57.3
3.0	16.42	4.00	0.26	0.16	160.1	278.1	317.7
6.0	15.85	1.03	0.17	0.03	100.5	26.7	322.5
12.0	15.75	0.02	0.01	0.02	181.4	341.5	183.2

[5] Journal of the Meteorological Society of Japan, 1904. [6] Ibid, 1905.

Values for the diffusivity of the soil are given in Table 9.

TABLE 9.

[In C. G. S. units.]

Depth, in meters.	$a^2{}_a$	$a^2{}_\phi$	$\frac{1}{2}(a^2{}_a + a^2{}_\phi)$
0.0–0.3	0.00304	0.00372	0.00338
0.3–1.5	0.00672	0.00353	0.00512
1.5–3.0	0.00899	0.00494	0.00696
3.0–6.0	0.00487	0.00829	0.00658

The author places more reliance on the values computed from the change of amplitudes than those obtained from the retardation of phase. The soil at a depth from 1.5 to 3.0 meters appears to possess the highest value of diffusivity.

Okada then computed, by means of the formula (18), the velocity of the annual temperature wave as it is propagated from the surface to the interior.

TABLE 10.

Depth, in meters.	Velocity, cm. per day.
0.0–0.3	3.4
0.3–1.5	3.3
1.5–3.0	3.9
3.0–6.0	5.0
Mean	3.9

Thus the velocity apparently increases with the depth and on the average would amount to $365 \times 3.9 \div 100 = 14.2$ meters per year if we could suppose that the soil were uniform to that depth.

The logarithmic equation for the amplitude at any depth (see equation 21), was found to be

$$a_z = 12.43\, e^{-0.0040884\, z}$$

which gives values for amplitudes fairly close to the observational values. By this formula the depth of the stratum of invariable temperature at Nagoya was calculated. It was found that the annual amplitude of temperature is reduced to 0.5° C at a depth of 7.8 meters and to 0.1° C at 11.8 meters. Hence the invariable stratum may be fairly assumed to lie at the depth of 12 meters at this place.

Finally, adopting von Bezold's formula[7], Doctor Okada determined the total amount of annual heat exchange in the ground at Nagoya to be 47.6 calories per square centimeter of ground surface, which is very close to that for Nukuss obtained by von Bezold himself.

(5) OKADA'S DISCUSSION OF OBSERVATIONS AT OSAKA.

Doctor Okada's second paper contains an analysis of the earth temperature data deduced from ten years observations (1895–1904) at Osaka, which is situated in latitude 34° 42′ north, and longitude 135° 31′ east from Greenwich and is five meters above sea level.

The ground in which the observations were made consisted chiefly of granitic sand, and the surface was flat and completely covered with sod. The depths at which the thermometers were placed were 0.0, 0.3, 1.2, 3.0 and 5.0 meters.

For the determination of the water capacity of the soil the author selected two samples of the soil; one was taken from the stratum 0.3 meter below the surface, and the other from the depth of one meter by boring. From the measured loss of weight by thorough drying it was found that the water content of the soil is practically the same, and average 0.074 gram per cubic centimeter. Of course the capacity is variable with the season, or strictly speaking, it varies from day to day.

The determination of the specific heat of pulverized matter, like soil constituents, is certainly a difficult task in practical physics. By the method of mixture Okada roughly determined the specific heat of the dry soil, the result being as follows:

TABLE 11.

No.	Specific heat.
I	0.203
II	0.203
III	0.196
IV	0.213
V	0.204
Mean	0.204

At Osaka the minimum temperature at the earth's surface occurs in January and the maximum in August; the minimum in February and the maximum in August at the depth of 1.2 meters; the minimum in May and the maximum in November at the depth of 5.0 meters. The annual mean temperature increases down to the depth of 3.0 meters and then decreases with depth.

TABLE 12.—*The constants of the harmonic formula (26) for Osaka.*

Depth, in meters.	θ	a_1	a_2	a_3	ϕ_1	ϕ_2	ϕ_3
	°C.	°C.	°C.	°C.	° ′	° ′	° ′
0.0	16.93	13.329	1.539	1038	261 06	344 18	164 32
0.3	16.84	11.880	1.020	0628	255 44	342 11	151 09
1.2	17.40	8.578	0.572	0369	235 09	326 42	120 02
3.0	18.05	4.188	0.119	0101	194 54	305 25	10 12
5.0	17.70	1.603	0.073	0029	143 40	255 01	306 08

The amplitude of the variation rapidly decreases with depth and the retardation of phase is approximately proportional to the depth if we leave that of the stratum at 5.0 meters out of consideration. The amplitude of annual variation of the underground temperature becomes very small with increasing depth, so that in general the determination of phase is very inaccurate.

Thus, the law that the retardation of phase is proportional to the depth, holds only approximately in natural soil owing largely to changes of structure and water content.

Doctor Okada obtained for an amplitude at any depth, x, the following equation:

$$\log a = \log (13.76) - 0.001825\, x.$$

By this formula it is easily known that the range of annual variation of temperature becomes 1° at the depth of 8 meters and 0.5 at 9.5 meters, and also that the annual amplitude practically vanishes at 12 meters below the earth's surface.

The values of the diffusivity of the soil at Osaka as obtained by Okada are given in Table 13.

TABLE 13.

Depth.	$a^2{}_a$	$a^2{}_\phi$	$\frac{1}{2}(a^2{}_a + a^2{}_\phi)$	k
0.0—0.3	0.00683	0.01024	0.00853	0.00341
0.3—1.2	0.00760	0.00626	0.00693	0.00277
1.2—3.0	0.00629	0.00655	0.00642	0.00257
3.0—5.0	0.00432	0.00499	0.00465	0.00186

The values of diffusivity deduced from the variation of amplitude and from the difference of phase agree fairly with each other, if we neglect the case of the earth's surface and also that of the stratum at the depth 0.3 meter.

Next, the values of diffusivity at Tokyo, Nagoya, and Osaka were compared, as in Table 14.

[7] If θ is the temperature at the depth x, C the heat capacity, H the depth of the stratum of invariable temperature, then the amount of heat which is introduced to the soil per unit area in the time during which the temperature increases from 0° to θ° is

$$Q = \int_0^H C\,\theta\, dx.$$

The difference between the maximum and minimum values of Q is the amount of heat exchange during the year. W. von Bezold, Der Wärmeaustausch. Berlin, 1902.

TABLE 14.

Place.	Soil.	0.0—0.3	0.3—1.2	1.2—3.0	3.0—5.0
Osaka ...	Sand.....	0.00853	0.00693	0.00642	0.00465
Tokyo ...	Loam.....	0.00320	.....	0.00301	0.00200
Nagoya..	Sand and loam..	0.00338	0.00512	0.00696	0.00658

At Osaka and Tokyo the diffusivity seemingly diminishes as we go into the deeper strata, while at Nagoya it increases with depth down to a certain stratum. The diffusivity of the upper layer at Nagoya is equal to that at Tokyo, while the diffusivity of the deeper stratum rather resembles that at Osaka. The reason for this, according Doctor Okada, is that the soil at Osaka is composed of granitic sand, and that at Tokyo of loam, while at Nagoya it is not uniform, the upper stratum being composed of loam and the deeper of sand with some loam. The conductivity of the Osaka soil decreases with depth, the mean conductivity being 0.00265 in C. G. S. units. Thus, the conductivity of sandy soil is one hundredth part of that of zinc, and is nearly equal to that of glass, while it is as much as ten times the conductivity of snow that has a density 0.18.

Applying Schubert's formula,[8] Doctor Okada computed the total amount of annual heat exchange to be 2163 gram-calories per unit area at the stratum of 4.0 meters below the surface. According to Angot the total annual amount of insolation at the latitude of 35° is 220018 gram-calories per square centimeter assuming the coefficient of transparency as 0.7 and the solar constant at 3 gram-calories per square centimeter per minute. Hence, the author concludes that the quantity of solar energy consumed in heating the soil is one-hundredth part of the total insolation which is received by the surface of the soil.

AN ACCOUNT OF RECENT METEOROLOGICAL AND GEO-PHYSICAL RESEARCHES IN JAPAN.

By Dr. S. TETSU TAMURA, Washington, D. C. Dated August 30, 1905.

The important scientific papers published in Japan are usually found in the Journal of the College of Science of the Tokyo Imperial University, in the Proceedings of the Tokyo Physico-Mathematical Society, or in the Journal of the Meteorological Society of Japan. I find, however, that neither of these publications are easily accessible in America, except in large Government bureaus or in prosperous university libraries. Moreover, those papers published elsewhere in Japanese are in no way accessible or intelligible to the western scientists. Perhaps this may be one of the reasons why Japanese scientific works are not duly known to American laymen as well as to scientists, though very brief references are given in "Science Abstracts". In the preceding article I have given an account of earth temperature investigations in Japan, and I am now induced to give some reviews, with occasional notes, of other memoirs by Japanese scientists on meteorology and its allied sciences.

1. PROF. F. OMORI ON THE ANNUAL VARIATION OF THE HEIGHT OF SEA LEVEL.

Professor Omori, of the Tokyo Imperial University, has published two papers on this subject in the Proceedings of the Tokyo Physico-Mathematical Society, Vol. II, Nos. 13 [1904], and 20 [1905]. The interesting feature of these papers is the comparison of the variation of the height of sea level with that of barometric pressure. In the first paper the author discussed their annual variations at Ayukawa, in the Province of Rikuzen, and Misaki, in the Province of Sagami, which two places are situated on the Pacific coast.

The following table gives the mean monthly relative heights of the sea level at Ayukawa and Misaki, deduced from the tide-gage observations during the year 1902, and also the mean barometric pressure in the vicinities of these places.

TABLE 1.

Month.	Monthly mean height of sea level.		Barometric pressure, reduced to sea level.
	Ayukawa.	Misaki.	
	mm.	mm.	mm.
I	121	129	761.3
II	0	0	764.5
III	23	69	762.2
IV	45	103	760.2
V	96	188	759.4
VI	171	171	756.1
VII	197	175	766.2
VIII	184	226	758.8
IX	219	276	758.7
X	172	246	764.1
XI	117	164	765.5
XII	157	257	761.0

From Table 1 it will be seen that the monthly variations of sea-level heights at Misaki and Ayukawa are quite similar, but just the reverse of the variations of barometric pressure. The range of the barometric variation is 9.3 mm., which corresponds to $9.3 \times 13.6 = 126$ mm., height of water. On the other hand, the range of the mean monthly variation of height of sea level is 276 mm. at Misaki and 219 mm., at Ayukawa, or twice as large as the range of the barometric variation. Hence, Professor Omori concludes that the sea bottom is subjected to a greater total pressure in the summer months than in February, March, and April. The cause of this elevation of the sea level in the summer the author attributes partly to the decrease of barometric pressure in Japan and its vicinities, and partly to the existence of the high pressure over the North Pacific Ocean, which causes the depression of the sea level in that region. In the winter the phenomena are just the reverse. From these facts Professor Omori explains why there are at the bottom of the west Pacific Ocean more earthquakes in the summer than in the winter.

The second paper by F. Omori contains the discussions of similar data obtained for four different places on the coast of the Japan Sea. The places are:

1. Hamada, in the Province of Iwami.
2. Wajima, on the northern coast of the Peninsula of Noto.
3. Iwasaki, on the western coast of the Province of Mutsu.
4. Otaru, in the Province of Shiribeshi, Hokkaido.

The mean monthly relative heights of the sea level at the four different places during 1902, and the monthly means of barometric pressure at the same places are given in Table 2.

TABLE 2.

Month.	Mean height of sea level at the four places.	Mean height of barometer at same places.
		mm.
I	112	761.38
II	0	764.20
III	48	761.61
IV	88	758.85
V	191	757.70
VI	206	757.21
VII	236	755.44
VIII	276	757.49
IX	312	757.55
X	257	763.64
XI	176	764.42
XII	181	761.37

From this table the annual variation of the barometric pressure will be seen, as in the case of the places on the Pacific coast, to be nearly the reverse of that of the height of sea level. Now the range of the former was 8.98 mm. which corresponds to $8.98 \times 13.6 = 122$ of water. The range of the variation of sea-level heights was 312 mm. Along the coast of the Japan Sea the variation of the sea-level height is opposite

[8] Zur Theorie der Wärmeleitung im Erdboden. Phys. Zeitschr, 1901. I Jahrgang, No. 41, p. 444.

to and nearly 2.6 times larger than the corresponding variation of the barometric pressure. Thus, the author reaches the same conclusion that the sea bottom is subjected to a greater total pressure in the summer months than in February, March, and April, just as it was found in Misaki and Ayukawa on the Pacific coast.

Finally, Professor Omori gives his computations of the monthly values of the relative total pressure at the sea bottom, i. e., the sum of the mean monthly values of the height of sea level and that of the barometer as in Table 3.

TABLE 3.

Month.	Pressure at sea bottom.
	mm.
I	193
II	119
III	132
IV	134
V	222
VI	230
VII	238
VIII	304
IX	341
X	368
XI	298
XII	262

According to this table the total pressure at the sea bottom was greatest in October and smallest in February, March, and April. The annual variation of sea-level height on the coast of the Japan Sea is perfectly similar to that on the Pacific coast.

2. DR. T. OKADA'S PAPER ON THE THERMAL CONDUCTIVITY OF SNOW.

The hourly observations of temperature at three depths, 10, 20, and 30 centimeters of accumulated snow, the surface of which was freely exposed to direct sunshine, were undertaken by Doctor Okada (now chief of the service of prediction of the Central Meteorological Observatory) in February, 1904, at Sapporo, which is situated in the western part of the northern island called Hokkaido. The means of the temperatures observed with long-stem mercurial thermometers at the specified depths for thirteen days, from the 5th to the 17th of the month, are given in Table 4.

TABLE 4.— *Temperature under the snow.*

Hour.	10 cm.	20 cm.	30 cm.	Hour.	10 cm.	20 cm.	30 cm.
1 a. m.	−4.68	−2.25	−1.71	1 p. m.	−3.44	−2.56	−2.00
2 a. m.	−4.90	−2.31	−1.77	2 p. m.	−2.98	−2.20	−1.99
3 a. m.	−5.04	−2.45	−1.80	3 p. m.	−2.66	−2.02	−1.96
4 a. m.	−5.08	−2.44	−1.84	4 p. m.	−2.62	−1.82	−1.68
5 a. m.	−5.24	−2.51	−1.87	5 p. m.	−2.72	−1.84	−1.72
6 a. m.	−5.40	−2.63	−1.92	6 p. m.	−2.82	−1.79	−1.66
7 a. m.	−5.44	−2.69	−1.94	7 p. m.	−2.82	−1.75	−1.65
8 a. m.	−5.42	−2.77	−1.97	8 p. m.	−2.96	−1.77	−1.67
9 a. m.	−5.40	−2.82	−1.94	9 p. m.	−3.02	−1.90	−1.63
10 a. m.	−5.08	−2.85	−1.96	10 p. m.	−3.10	−1.96	−1.60
11 a. m.	−4.62	−2.83	−1.95	11 p. m.	−3.10	−2.03	−1.64
Noon.	−4.02	−2.75	−2.01	Midnight.	−3.16	−2.13	−1.70
				Mean.	−4.01	−2.29	−1.77

The author next undertook the observations of the density of snow at different depths, and found the following values from three observations at each depth:

Depth in centimeters	5	25	34	45
Density in C. G. S. units	0.13	0.24	0.29	0.35

As is pointed out by the author, the density of the accumulated snow regularly increases with the depth. The following linear equation, connecting the observed density and the depth, was obtained by Okada:

$$\rho = 0.101 + 0.0055\,x$$

where ρ denotes the density and x the depth in centimeters. Then, applying the amplitude equations[1]

$$\log_e a = \log_e a_0 - x\sqrt{\frac{\pi}{a^2 T}}$$

or

$$\log_e a = \log_e a_0 - px$$

where a is the amplitude at any depth x of snow, a_0 that at the surface, a^2 the diffusivity of the snow, and T the period, Doctor Okada computed the values of p and a^2, which are given as follows:

Depth.	10–20 cm.	20–30 cm.
p	0.1089	0.0982
a^2	0.0031	0.0038

Now $a^2 = \frac{k}{\rho c}$, where c is the specific heat of snow.

According to Okada's formula representing the relation between the density and the depth of snow, the mean density of snow for the stratum from 10 to 20 cm. is found to be 0.18 and that for the stratum 20 to 30 cm. to be 0.24. Hence, assuming the specific heat of snow to be 0.508, the author obtained 0.00028 for the conductivity of snow for the stratum from 10 to 20 cm. and 0.00045 for that from 20 to 30 cm.

The conductivity of snow is found to vary with its density. H. Abels deduced from his hourly observations at Katharineburg the formula

$$k = 0.00068\,\rho^2$$

and M. Janssen obtained from his laboratory experiments the formula

$$k = 0.00005 + 0.0019\,\rho + 0.006\,\rho^4.$$

With these formulæ, Doctor Okada computed the values of the conductivity of snow for $\rho = 0.18$ and $\rho = 0.24$, and compared his own values:

Density.	Abels's formula.	Janssen's formula.	Okada's values.
0.18	0.00022	0.00039	0.00028
0.24	0.00039	0.00051	0.00045

Here the author points out that his values are equal to the means of the values calculated by Abels's and Janssen's formulæ.

The following memoirs are referred to by Doctor Okada:

(1) Hjelström: Ueber die Wärmeleitung des Schnees. Met. Zeit., Bd. VII, 226.

(2) H. Abels: Beobachtungen der täglichen Periode der Temperatur in Schnee und Bestimmung des Wärmeleitungsvermögen des Schnees als Function seiner Dichtigkeit. Rep. für Meteor. Bd. XVI, No. 1, 1892.

(3) M. Janssen: Ueber die Wärmeleitungs fähigheit des Schnee. Öfversigt af Kongl. Vetenskaps-Akademiens Förhardlingar, 1901, No. 3.

3. DR. K. HONDA'S PAPER ON DAILY PERIODIC CHANGES IN THE LEVEL OF ARTESIAN WELLS IN JAPAN.

Doctor Honda's present discussion of this problem was published in the Proceedings of the Tokyo Physico-Mathematical Society, Vol. II, No. 6, 1903, and Vol. II, No. 9, 1904, and in the publications of the Earthquake Investigation Committee, No. 18, 1904. It is based upon his observations of level in an artesian well at the Tokyo Imperial University, which is 5.7 kilometers distant from the sea and 15 meters above sea level. The well is 380 meters deep and lined with iron tubes 14 centimeters in diameter. From the observations the author reaches the following conclusions:

1. The water level has two maxima and minima in 24 hours, with a range of from one to three centimeters.

2. The fluctuations are markedly regular about new and full moon, resembling the ocean tide, the range being considerably greater than at the half moon.

3. The phases of maxima and minima of the water level in the well correspond to those of the tides in the Tokyo Bay; high-water level corresponds to high tide.

4. The phases of the maxima and minima of the well water level are directly opposite to those of the diurnal maxima and and minima of the atmospheric pressure about new and full moon; but as we approach the half moon the difference of the phases becomes smaller and smaller.

[1] See the note on the "Mathematical theory of the linear flow of heat," in the current number of the MONTHLY WEATHER REVIEW, by S. T. Tamura.

5. High atmospheric pressure lowers the water level and low atmospheric pressure causes high water level.

6. Rains appear to have no effect on water level.

Next the author shows, that as the curve of variation of water level is simple and regular, there must be one principal cause of the change, the others, if there be any, must be subordinate and not essential. Now the author shows that this main cause may be the existence of a porous layer containing gas underneath the well, so that high barometric pressure in the surface air forces the water from the well into the cavities, but low pressure lets it flow back again. The tides have a similar, but opposite effect. A closed jar was fitted over the mouth of the well. The change of the air pressure in this jar caused artificially by a change of 1 mm. of mercury produced a change of 13.5 mm. in the water level. But as the natural air pressure acts both on the water and the ground about the well, the observed change of 4.35 mm. in the water level, corresponding to 1 mm. change of the air pressure, is a differential effect, representing 32 per cent of the barometric fluctuation. Thus, the earth's crust would transmit 68 per cent of air pressure on the surface to a depth of 380 m. Hence, the author concludes that the daily fluctuations in the water level are essentially due to tides. The observations of the wells in Yokohama, 2 kilometers from the sea coast, Yoshiwara (3.3 kilometers), Okubo (6.4 kilometers) confirm the existence of a porous layer or air space in the ground. Finally, the author explains why Professor Omori finds that the maximum earthquake activity which generally coincides with high barometers is at some stations accompanied by low barometers.

4. PROF. Y. WADA'S TEMPERATURE MOYENNE ANNUELLE DE LA SURFACE DE LA MER DANS L'OCEAN PACIFIQUE OCCIDENTAL.

This paper by Prof. Y. Wada, who was then the chief of the service of prediction in the Central Meteorological Observatory of Japan, and is now the director of the Japanese Weather Service in Korea, was published in 1904 in Bulletin No. 1 of the Central Meteorological Observatory. The tracing of the isotherms of surface water and the discussion of the distribution of the temperature in the sea surrounding the Japanese Islands are based upon the observations of twenty years (1882–1901) on ships by the members of the Central Meteorological Observatory. The number of vessels amounted to 1086, of which 848 belonged to Japan and the rest to foreign countries. The region of observation comprises the area between longitudes 114° and 146° east of Greenwich and latitudes 22° and 46° north. This vast area was divided into squares of two degrees on each side. The number of observations, however, differs accordingly to the month and the location of the squares. The total number of observations is 133,255, eight-tenths of which belong to the region between the longitudes 128° and 140° east, and the latitudes 30° and 42° north.

The thermometer which is ordinarily used on Japanese ships, in order to measure the temperature of the sea water, is of the same form as that used on foreign ships. It is a mercury thermometer whose scale is not directly engraved on the stem, but on a metallic plate which is fastened to the stem. The stem and scale are placed in a metallic case which carries at the lower part a reservoir of water in which the bulb of the thermometer is plunged. In order to observe the surface water, a linen bag (sac toile) is thrown into the sea. After dipping it until its temperature becomes the same as that of the water, the bag is pulled up and the temperature of the water in it is measured. The hours of the observations on Japanese ships were 2^h, 6^h, 10^h both in the morning and evening, but older observations were generally taken at 4^h and 8^h in the morning, at noon, and at 4^h and 3^h in the evening and at midnight.

In the period of twenty years and in the regions above mentioned, the highest mean temperature of the surface sea water was 30° C., observed in August at the Formosan Strait, and the lowest, —3° C., in the Gulf of Pechili and also in the Japan Sea (in the vicinity of Vladivostok), the former occurring in the months of January and February, and the latter in December. The annual range is 33° C., taking the whole region into consideration. If we consider the annual range of variation in each region, we observe that it generally increases with the latitude. While the annual range is only 6° or 7° at low latitudes, it goes beyond 20° at the latitudes higher than 30° north. The range, however, diminishes gradually as we go farther from continents. The region which has the greatest annual range is the Gulf of Pechili (China), where the mean temperature of the month of August attains 24° C., and that of February, —3° C., so that the annual range is 27° C. The smallest annual range of 6° is found in the vicinity of Cape South (Formosa), where the temperature of August is 28° and that of February is about 22°.

Location.	Mean maximum temperature.		Mean minimum temperature.		Annual range.
	°C.	Mo.	°C.	Mo.	°C
Strait of Formosa	30	August	15	January	15
Strait of Pescadores	28	August	15	January	13
East side of Formosa	28	August	15	February	13
Loo Choo Archipelago	29	August	14	January	15
West side of Kinshu	28	August	16	February	12
East side of Kinshu	29	August	10	January	13
South side of Shikoku	27	August	13	March	14
Interior sea	27	August	9	February	18
South side of main island	26	August	14	February	12
Southeast side of main island	26	August	11	January	15
East side of main island	25	August	7	February	18
Strait of Tsugaru	22	August	6	February	16
South of Hokkaido	22	August	2	March	20
East of Hokkaido	19	August	—1	February	20
Okhotsk Sea	19	August	—3	March	22
West of Hokkaido	22	August	3	February	19
Northwest of main island	26	August	7	February	19
West of main island	27	August	10	February	17
Siberian coast	23	August	—2	December	25
East of Korea	25	August	3	February	22
Korean Strait	27	August	11	February	16
West of Korea	25	August	1	February	24
Gulf of Pechili	24	August	—3	February	27
Yellow Sea	27	August	0	February	27
Chinese coast	27	August	0	February	27
East China Sea	28	August	11	February	17

Professor Wada further points out that, with some exceptions, the march of the temperature of the sea follows very nearly the direction of the ocean currents. It is known that the seas surrounding Japan are under the direct influence of two contrary currents, one being the equatorial and the other the polar. The former, which is called Kuroshiwo, runs along Formosa, Loo Choo, and then divides itself into two currents. The principal current runs along Kinshu and Shikoku islands and then along the main island as far as the latitude of 36°, at which it quits the Japanese coast. The other branch passes into the Japan Sea from the west of the Japanese Islands, and then runs toward northeast along the coast of Japan, finally entering the Sea of Okhotsk.

The polar current which comes down along the Kurile Islands, passes the eastern extremity of Hokkaido, and then runs meridionally to the east of the main island as far as latitude 36°. Besides, another branch of the polar current appears to run down along the Siberian coast, touching Korea. In the regions where the currents run the annual changes of the temperature are relatively small, while they are very large in those regions where there are no currents. For instance, in the Gulf of Pechili, which is surrounded by the continent, the features of the isotherms for each month show convincingly the existence of those currents and also the changes of their directions in the course of the year.

Finally, Professor Wada discusses in detail the distribution of the temperature on the surface of the sea in each month of the year, and gives tables of the variations of temperature within each square (2° × 2°) from month to month, and thirteen charts of isotherms which were traced from the above

data. These charts comprise the twelve charts of isotherms for the twelve months, and one chart of annual isotherms. They are most noteworthy and interesting, and will throw much light on meteorological and climatological conditions in eastern Asia.

THE VARIATION IN MINIMUM TEMPERATURES ON STILL, CLEAR NIGHTS WITHIN THE CONFINES OF A VILLAGE.

By Prof. WILLIS I. MILHAM, Ph. D., Williamstown, Mass. Dated August 4, 1905.

The present investigation was suggested by the reports of extremely low temperatures from different parts of a village, while a registering minimum thermometer, exposed in a regular thermometer shelter, gave much higher readings. The purpose of the investigation was to determine, among other things, the amount of the total variation, the influences that determine the amount of the variation, and the regularity with which a certain station is either colder or warmer than other stations. The observations were made in the village of Williamstown, the seat of Williams College, which is located among the Berkshire Hills of western Massachusetts. The village is situated in the middle of a saucer-like depression about three miles in diameter, surrounded by fairly high mountains, the highest peaks of which range from about 1200 feet to 3505 feet (Greylock Mountain). There are two main valleys leading into this depression, one from the east and one from the south. The outlet through which the Hoosic River flows is to the northwest. The village proper is about one and one half miles long and three quarters of a mile wide, and is situated on three small knolls in the middle of this depression; it consists of detached houses, surrounded by ample lawns and gardens, and the streets are wide. The accompanying map, fig. 1, shows the streets and water courses; the contour lines, drawn every ten feet, give the elevation above mean sea level.

The thermometers used in this experiment were exposed at ten different stations in the village. These stations are numbered from one to ten, and each location is indicated on the accompanying map. A scale of distances and the true north and south direction have been added, so that in every case the elevation, the direction of the slope, the steepness of the slope, and the distance from running water can be determined from the map. It will be seen that Williamstown has a very diversified surface, consisting of fairly level areas, marked valleys, plenty of running water, and differences of elevation amounting to 120 feet. It is, therefore, well suited to the investigation of this problem.

The thermometers used were self-registering, minimum, alcohol thermometers of the regular Weather Bureau type, made by H. J. Green, of Brooklyn, N. Y. Each one was mounted on an unpainted pine board, about eighteen inches long and seven inches wide, exposed in the open, without a shelter of any kind, exactly five and one half feet from the surface of the ground, on the northwest side of a post or small tree at least fifteen feet from the nearest building, and always with a clear space of at least forty feet on the northwest side. The ground was covered with snow during the whole experiment, so that the surface under each thermometer was the same. Absolute uniformity in every particular was aimed at in exposing the thermometers.

The variations treated in this article are not due to inaccuracies in the thermometers, as the following precautions were taken:

(1) All the thermometers were wrapped up together in cloth and placed in a room where the temperature was nearly constant. At the end of several hours every thermometer indicated the same temperature within one or two tenths of a degree. This was done at the beginning and end of the investigation. (2) The thermometers were all read on several different occasions during high winds, while the temperature was changing slowly and the sky was covered with clouds. The readings always differed from the mean of all readings by less than one degree. (3) The thermometers were frequently changed from station to station during the investigation.

The observations were made during the winter of 1904–5 and are given in full for 36 nights in the accompanying Table 1. Observations were always taken when the temperature fell to zero or below at any point in Williamstown; also several additional sets when the temperature fell nearly to zero. The table thus contains observations for practically every night when there was a decidedly low temperature. A few observations are missing. Two thermometers were not put into commission at the beginning of the investigation and the other observations were lost for reasons which are of no interest here. These missing observations, however, in no way influence the conclusions which are drawn. Extreme care was used in setting the thermometers and making the readings and every effort was made to avoid all errors that might result from causes such as the jarring of the thermometer by the wind, careless setting or reading, tampering with instruments by unauthorized persons, etc. The first column of the table contains the date of observation. Even if the minimum occurred before midnight, the date given is always that of the following morning, when the readings of the thermometer were made.

Williams College is a cooperative station of the U. S. Weather Bureau and its shelter for the thermometers is of the form advocated by the Weather Bureau and is placed on the north side of an unheated building. There is an ample air space between the building and the shelter, and the instruments are five and one-half feet above the ground. The column under "Station" headed "A" contains the observations of minimum temperature made in this thermometer shelter. Station 1 was twenty feet north of this shelter and thus serves as a connecting link between observations made in a regular thermometer shelter and observations made in the open without a shelter as is the case with the ten stations. The columns under "Stations" and numbered 1 to 10 contain the observations made at ten stations whose positions are indicated on the map. The column headed "B" contains the observations made on a registering, minimum thermometer exposed on a small iron post of a piazza on the north side of a house. The thermometer was five and one-half feet above the floor of the piazza, six feet from the house and twenty feet southeast of station 8. These observations are added as this is a favorite way among people living in a village of exposing ordinary thermometers. The column headed "Total variation" gives the difference between the higher and lower temperatures observed at the ten stations on the night in question. The next column gives the characteristics of the night as regards the wind. The letters indicate the direction of the wind at 10:30 p. m. and it will be seen that it was from the northwest in every case. If the wind changed during the night this is indicated by a [*] and in every case it changed to either the east or southeast. The two numbers separated by a dash give the estimated wind velocity in miles per hour at 10:30 p. m. and at the time of the minimum. These are estimated velocities their absolute values may be somewhat erroneous, but they will nevertheless serve to designate the relative windiness of the different nights. The next column gives the character of the sky at the time of the minimum; the adjectives used are cloudless, thin haze, haze, thinly overcast, overcast. The next column gives the depth of the snow on the ground in inches; it will be seen that all the observations were taken over a snow surface, thus affording absolute uniformity as regards the radiating surface. The last column gives additional facts which may be of interest. Whenever

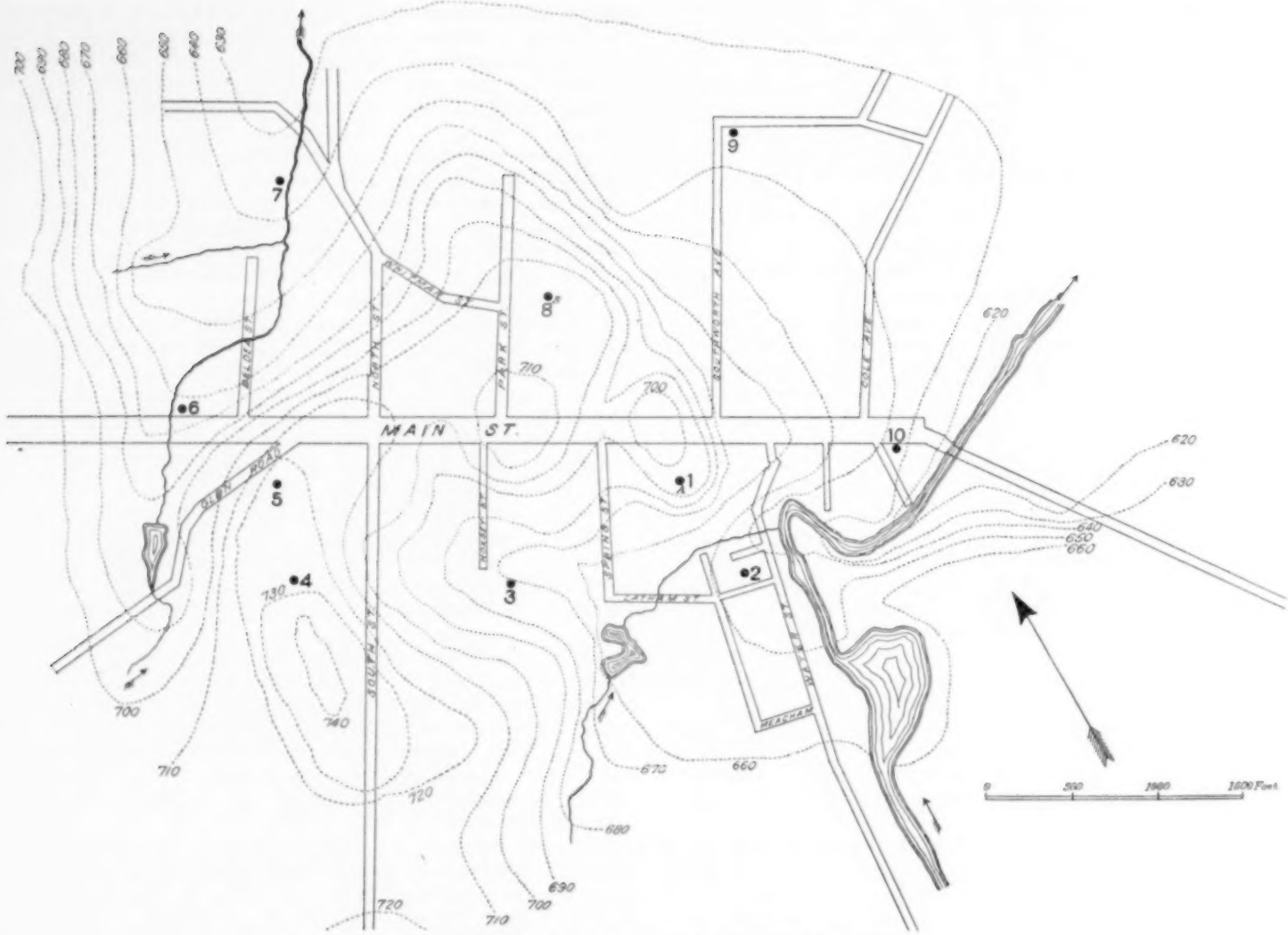

FIG. 1.—Contour lines of the village of Williamstown, Mass.

the minimum did not occur at sunrise or just before, the exact time of the minimum is given in this column.

As a result of these observations the following conclusions may be drawn:

I. AMOUNT OF THE TOTAL VARIATION.

The total variation for each night is found by subtracting the lowest value of minimum temperature observed at any station from the highest value. The 36 values of total variation all fall between the limiting values of 1.0° and 10.0° and the average is 5.1°. An inspection of the 36 values also shows that there is practically no bunching in the neighborhood of the mean value of 5.1°, but that the distribution is fairly uniform between the limiting values of 1.0° and 10.0°.

II. THE INFLUENCES WHICH DETERMINE THE AMOUNT OF THE TOTAL VARIATION.

(1) *Wind.*—The largest value of estimated wind velocity, twelve miles per hour, at the time of the minimum, occurred on January 26, and it will be noticed that the smallest value of total variation, namely 1.0°, was also observed on that date. The three next largest values of estimated wind velocity at the time of the minimum, namely, ten miles on January 4, six miles on February 3, and four miles on February 19, had corresponding total variations of 2.2°, 2.0°, and 2.2°, respectively. These values are far below the average value of total variation, namely, 5.1°. The theoretical expectation that wind would thoroughly mix the lower layers of the atmosphere and render the temperature at different localities fairly uniform is thus verified by the observations. The fact that the readings of all the thermometers are so nearly the same during a wind could also be used as an argument for the accuracy of the thermometers and the uniformity of their exposure.

(2) *The type of night.*—The largest value of total variation, namely, 10.0°, occurred on January 23. There were six inches of snow on the ground at the time, part of it newly fallen. At 10:30 p. m. the wind was blowing gently from the northwest and the sky was cloudless. The minimum occurred just before sunrise and at that time it was absolutely still and there was not a particle of haze or cloud of any kind. The next five largest values of total variation, namely, 9.0° on December 15, 8.0° on December 19, 9.0° on December 22, 7.5° on February 12, and 8.0° on February 15, all occurred on nights of the same type, but entirely different from the one just described. In these cases the wind blew gently from the northwest in the early evening, but soon died down and became calm. The wind then changed to the east or southeast during the night. The minimum always occurred early—as will be seen from the observations between 10 p. m. and 4 a. m. On these nights the sky was hazy or overcast at the time of the minimum. Often in the early morning the sky was entirely covered with clouds, the wind strongly from the east or southeast, and a rise of 20° in temperature; precipitation sometimes followed before noon. It would seem that the coming east wind, either by transportation or mixture, replaced the cooling air of the more exposed or elevated stations with warmer air, thus preventing a drop in temperature while the air in the valleys and less exposed places was allowed to

TABLE 1.—*Record of observations of minimum thermometers at Williamstown, Mass.*

Date.	Station. A	1	2	3	4	5	6	7	8	9	10	B	Total variation.	Wind.	Character of the sky at time of minimum.	Snow.	Remarks.
December 10	0.5	.....	− 7.0	.....	− 3.4	.....	.....	− 8.0	− 3.0	− 4.5	− 3.0	1.0	5.0	nw., 4-0	Overcast	2	
11	− 3.0	.....	− 7.5	− 7.2	− 7.9	.....	− 7.5	− 7.0	− 7.0	− 6.0	− 6.0	− 3.0	1.9	nw., 3-0	Cloudless	2	
12	− 1.0	.....	− 5.2	− 6.0	− 3.9	.....	− 4.8	− 6.5	− 3.8	− 4.0	− 2.0	1.0	4.5	*nw., 4-0	Overcast	2	Minimum 2 a. m.
14	4.0	.....	1.0	0.8	− 1.0	− 1.0	1.8	0.0	2.0	2.0	2.8	3.5	3.8	nw., 3-0	Overcast	5	New snow.
15	− 1.6	− 6.0	−10.5	− 9.6	− 7.8	− 7.0	− 9.0	−14.0	− 5.0	− 7.2	− 7.0	0.0	9.0	*nw., 3-0	Overcast	5	Minimum 11 p.m.
19	1.0	− 3.0	− 8.0	− 6.7	− 3.4	− 4.0	− 6.1	−10.0	− 2.0	− 5.5	− 3.5	1.0	8.0	*nw., 1-0	Haze	5	Minimum 3 a. m.
22	9.8	2.0	3.4	4.0	2.0	3.0	− 1.8	− 4.0	5.0	2.0	3.0	9.0	9.0	*nw., 15-0	Overcast	6	Minimum 2 a. m.
25	0.0	− 1.8	− 2.0	− 2.8	− 2.9	− 2.5	− 2.8	− 3.0	− 1.5	− 2.0	− 1.1	0.8	1.9	nw., 2-1	Cloudless	1	Snow dirty.
January 4	0.0	.....	− 3.0	− 2.2	− 1.8	− 2.0	− 1.0	− 3.0	− 1.0	− 1.0	− 0.8	2.2	2.2	nw., 15-10	Overcast	11	New snow.
5	− 6.0	− 9.8	−14.0	−12.0	−12.9	−12.0	−13.0	−14.0	−10.0	−11.5	−10.5	− 6.0	4.2	nw., 3-1	Thinly overcast.	11	
11	10.0	.....	3.0	.....	5.0	4.0	3.0	1.0	8.0	5.0	6.5	10.0	7.0	nw., 3-2	Haze	11	Wind gusty.
15	− 1.0	− 4.0	− 4.5	− 5.5	− 6.0	− 6.5	− 5.2	− 7.0	− 4.0	− 3.5	− 3.5	0.0	3.5	nw., 6-0	Thin haze	6	
23	4.0	− 1.0	− 7.5	− 5.0	− 4.5	− 3.7	− 7.5	−11.0	− 1.0	− 8.0	− 4.2	3.0	10.0	nw., 4-0	Cloudless	6	New snow.
24	− 8.0	−13.0	−16.0	−15.9	−13.0	−14.0	−14.0	−16.5	−12.0	−14.0	−12.0	− 7.0	4.5	*nw., 2-0	Thin haze	6	
26	− 3.6	.....	− 4.8	.....	− 5.0	− 5.5	− 5.0	− 5.0	− 5.0	.....	− 4.5	− 2.0	1.0	nw., 20-12	Cloudless	7	
27	− 3.0	− 5.8	− 9.0	− 9.5	− 8.0	− 8.8	−10.0	−11.0	− 7.0	− 5.0	− 6.2	− 2.0	6.0	*nw., 2-0	Overcast	6	Minimum 11 p.m.
29	7.0	5.2	2.0	2.5	4.5	2.0	− 0.1	− 1.5	3.5	1.8	2.5	8.0	6.7	nw., 7-1	Thinly overcast.	6	
30	5.0	2.5	0.0	0.0	1.0	0.5	− 1.0	− 2.5	3.0	3.8	2.8	6.0	6.3	*nw., 4-0	Overcast	5	
31	− 6.5	−10.6	−12.0	−12.5	−11.8	−12.0	−13.0	−14.0	−10.0	−11.2	−10.0	− 5.5	4.0	nw., 1-0	Overcast	5	
February 1	− 1.5	− 4.2	− 7.0	− 7.0	− 5.5	− 6.5	− 8.0	− 9.0	− 3.5	− 4.5	− 4.5	0.0	5.5	nw., 3-0	Cloudless	5	
3	0.0	.....	− 2.0	.....	− 2.0	− 3.0	− 2.0	− 2.0	− 2.0	− 1.0	− 1.5	1.0	2.0	nw., 25-6	Cloudless	5	
4	− 5.0	− 8.5	− 9.5	−11.0	−11.0	−11.0	−13.0	−13.0	− 8.0	− 7.8	− 8.0	− 4.0	5.2	nw., 6-1	Cloudless	5	
5	− 8.0	.....	−13.5	.....	−14.0	−15.0	−15.8	−16.0	−10.5	−12.0	−11.0	− 6.0	5.5	nw., 6-0	Cloudless	5	
8	− 3.0	− 5.5	− 9.8	− 9.0	− 7.9	− 7.5	−12.3	−12.0	− 6.0	− 8.0	− 6.8	− 1.0	6.8	*nw., 12-0	Cloudless	6	New snow.
12	− 5.0	− 8.9	−12.0	−11.0	− 9.6	− 9.8	−12.0	−15.5	− 8.0	− 9.5	− 8.5	− 4.0	7.5	*nw., 3-0	Overcast	6	Minimum 4 a. m.
14	− 1.0	− 4.5	− 7.2	− 7.5	− 5.5	− 6.5	− 7.0	−10.0	− 5.0	− 3.6	− 4.0	0.0	6.4	nw., 10-2	Cloudless	10	New snow.
15	5.5	3.5	− 1.0	.....	0.2	− 2.0	− 4.5	.....	0.0	− 2.5	− 0.2	3.0	8.0	*nw., 0-0	Overcast	10	Minimum 10 p.m.
16	− 4.0	− 8.0	−10.5	− 9.5	−10.0	−10.2	−13.5	−14.0	− 8.7	− 9.0	− 8.5	− 3.0	6.0	nw., 9-1	Cloudless	11	New snow.
19	2.0	− 1.0	− 3.0	.....	− 0.8	− 2.8	− 3.0	− 3.0	− 1.2	− 2.5	− 1.8	2.0	2.2	nw., 15-4	Cloudless	12	Wind gusty.
25	3.5	.....	− 4.0	0.0	− 1.0	− 1.5	− 2.0	− 5.5	0.9	− 1.5	0.0	5.5	6.4	nw., 3-1	Cloudless	7	Old snow.
28	11.0	7.8	5.0	5.0	6.0	.....	6.0	2.5	7.5	7.0	7.0	11.0	5.3	*nw., 4-1	Overcast	6	Minimum 3 a. m.
March 1	4.0	.....	− 2.2	− 2.0	0.5	− 1.5	− 0.5	− 2.5	2.0	1.0	1.5	6.0	4.5	nw., 4-1	Cloudless	6	
2	2.5	− 2.0	− 5.0	.....	− 3.0	− 4.0	− 5.0	− 8.0	− 2.0	− 3.5	− 2.0	3.0	6.0	nw., 3-0	Cloudless	6	
3	4.0	0.0	− 3.2	.....	− 0.5	− 1.5	− 2.5	− 6.0	0.2	− 1.2	0.0	5.0	6.2	nw., 2-0	Overcast	6	
7	2.5	− 0.8	− 4.0	− 4.0	− 2.0	− 3.5	− 3.0	− 5.0	− 0.5	− 0.5	0.0	3.0	5.0	*nw., 1-0	Cloudless	6	Snow very dirty.
Average	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.1	.....	.....	.....	
Average variation as compared with station 8	3.2	− 0.7	− 2.7	− 2.5	− 1.5	− 2.2	− 3.2	− 4.8	0.0	− 1.1	− 0.3	3.9	.....	.....	.....	.....	
Limits of the variation	1.0 to 4.8	3.0 to − 3.5	0.2 to − 6.5	− 0.2 to − 4.7	1.0 to − 3.5	− 0.5 to − 4.5	0.0 to − 6.8	0.0 to −10.0	.....	2.0 to − 7.0	1.8 to − 3.2	1.5 to 5.0	.....	.....	.....	.....	
Elevation of station, feet	.....	698	648	672	723	725	662	635	701	634	633	.....	.....	.....	.....	.....	

remain and become cold by radiation and conduction. This would explain the large total variations on this type of night.

(3) *The existing temperature.*—The average value of total variation on the ten coldest nights at station 8 is 5.2° with an average temperature of 8.7° below zero, while the average value of total variation on the ten warmest nights is 6.3° with an average temperature of 3.2°. It thus seems safe to draw the conclusion that the amount of total variation does not depend markedly on the coldness of the night, and certainly does not become greater the colder the night. And this is what one would theoretically expect, for radiation is the only element producing the variation which can depend on the coldness of the night, and here we have to do with only the relative radiation of the different stations. These influences may be summarized as follows: The amount of the variation is much less on a windy night, is not influenced by the coldness of the night, and is greatest on the two types of nights described above.

III. CORRELATION OF VARIATION AND LOCALITY.

Thus far the amount of the total variation, and the conditions that influenced it, have been treated without considering which station happened to be the coldest and which the warmest. The next natural question is this: Are certain stations always the colder ones while others are always above the average? If this definite distribution of the larger and smaller values of minimum temperature among the stations does exist, what is its cause? There are three ways by which an idea of the definiteness of this distribution can be obtained.

(*a*) First from the statistics given in the last three rows of of the table of observations. Station 8 was taken as the one with which to compare the others, as it happened to be the warmest station. It will be noticed in the case of station 1, for example, that it averaged 0.7° colder than station 8, but varied on different nights all the way from 3.0° warmer to 3.5° colder. Station 7, however, averages 4.8° colder than station 8, and varies all the way from being as warm to 10.0° colder. This station was never warmer than station 8. The corresponding facts are given in the table for the other stations.

(*b*) The following summary furnishes a second way of forming a picture of the definiteness of the distribution. During the 36 nights on which observations were recorded, the following stations were warmest or coldest by the indicated number of times. When two or more stations had the same temperature and were either warmest or coldest it is noted as warmest or coldest for each of them:

Warmest station.		Coldest station.	
Station 8	16 times.	Station 7	30 times.
Station 10	12 times.	Station 6	4 times,
Station 1	8 times.	Station 5	3 times.
Station 9	7 times.	Station 2	3 times.
Station 4	1 time.	Station 4	2 times.

(*c*) Thirdly, by following down two columns of observations in the table of observations (those for stations 7 and 8 are particularly well suited) it can not fail to be noticed with what regularity one of the stations is colder than the other.

A summary of the observations carried on during a single winter is thus sufficient to locate each station definitely in a scale of relative coldness, but the distribution of minimum temperatures is not so definite that observations for one or two nights would be sufficient to determine the relative coldness of a number of stations in an unknown locality. It is natural to think of elevation as the chief cause of the variation in minimum temperatures. When the air temperature at a

station changes during the night it is the result of radiation and conduction, or transportation, or both. If the wind is blowing, then warmer air from high altitudes (an inversion of temperature is here assumed) or other localities, or colder air from some other locality, may be mixed with or even replace the air at some particular station. If the wind is not blowing, there would still be the natural drainage of colder, and thus denser air into the valleys from places of greater elevation. Thus, not only elevation, but also the openness of a valley, its direction, the roughness of the surface, and the direction from which the wind comes, would play a part in determining the minimum temperature. When we turn to the observations it will be seen that in fact elevation does play an important part. The valley on the west side of the village is well marked and the steady increase of coldness from station 4, past stations 5 and 6, westward to station 7 is very pronounced in the table of observations. The same thing is well marked between stations 7 and 8 and also between stations 1 and 2. On the other hand stations 8 and 9 and also stations 1 and 10 are practically of the same coldness although there is a marked difference in elevation. It will be seen from the elevations given in the table of observations that the highest station is not the warmest and the lowest station is not the coldest. The conclusion which must be drawn is this: Elevation plays an important part, but it must by no means be stated that stations can be arranged in order of coldness depending upon their elevation alone.

IV. THE EFFECT OF A THERMOMETER SHELTER.

The observations recorded in the column "A" were the readings of the registering, minimum thermometer in the thermometer shelter. They average 3.2° warmer than station 8, while station 1 averages 0.7° colder. This makes the readings at station A average 3.9° warmer than station 1. A direct comparison of the observations made at stations A and 1 for the nights when both were recorded makes A 3.7° warmer than station 1, with 1.8° and 7.8° as the limits in the variation. This means that during the still, clear winter nights a registering minimum thermometer exposed in the standard thermometer shelter reads on the average between 3° and 4° higher than the same instrument exposed in the open.

V. EFFECT OF A PIAZZA.

The column headed "B" contains the observations made on the piazza of a house twenty feet southeast of station 8. The readings average 3.9° warmer than station 8, with 1.5° and 5.0° as the limits of the variation. It will thus be seen that even on the post of a north piazza, a thermometer may read nearly 4° too high on still, clear winter nights.

This investigation might be extended in two directions. The given observations were all made while the ground was covered with snow. A similar series made during the summer when the ground is covered with vegetation would give an interesting comparison.

Station 8 has been found to be the warmest while station 7 is the coldest. By placing a number of thermometers between these two stations and taking readings every hour or every two hours during certain nights in winter interesting results might be obtained as to the relative importance of conduction and radiation and transportation of air in determining the temperature.

EARTHQUAKES RECENTLY RECORDED AT THE WEATHER BUREAU.

By C. F. MARVIN, Professor of Meteorology. Dated August 7, 1905.

Several distant earthquakes have recently been registered at the Weather Bureau, one of which was by far the most important lately experienced. No motion was felt on this occasion by any individuals so far as known; in fact the curious thing is that no accounts of any great earthquake or other disturbance that could produce the records we find have been reported in the public press anywhere. Reports from distant observatories at which seismographs are maintained are not available at the present time, but there is no doubt that the disturbance was registered all over the world.

The displacements shown by the Bosch-Omori seismographs at Washington were several times greater and many times more numerous than in the case of the great Indian earthquake of April 4. Other cases have likewise occurred in which great unfelt disturbances have been registered seemingly unaccompanied at any known or inhabited portion of the globe with such surface disasters as we are led to look for or as seem to be required to explain the occurrence of our records. Even where earthquakes occur deep under the sea, at great distances from land, we expect them to be accompanied by tidal waves of greater or less magnitude as tangible evidence of their occurrence. When, therefore, we find large disturbances recorded without being able to trace them to any obvious cause the question may be asked: Can the origin of these great effects possibly be so deep seated within the earth that the waves reaching the surface are not only feeble, but are not even of the same character as those we feel and that destroy buildings, etc. The suspicion may be awakened in the minds of some not familiar with the maintenance of modern seismographs that the records are not genuine, or may be due to some accidental local causes. This can not possibly be the case. No human, nor accidental, nor artificial agency can possibly produce one of these records *de novo* in all its minute perfection. It may be copied and duplicated, or possibly imitated if an elaborate machine were constructed for the purpose, but nothing but real motions in the crust of the earth can cause the instrument itself to produce such original records as these.

This last great disturbance began at Washington at 10^h 13^m p. m., of July 22, seventy-fifth meridian time, and from that time on for more than two hours and a half perceptible movements of the earth crust were being registered. For a period of nearly twenty-three minutes, from 10:30 to 10:53 p. m., the motions, especially in the east and west directions, were unusually great, the maximum wave to the west measuring 5.4 millimeters, while the pen went off the sheet three times in the east direction, which required a movement of more than 5 millimeters.

The entire records for this earthquake are shown on Plate I.

Tables 1, 2, 3, and 4 present the principal characteristics of the several earthquakes registered on the seismograph at the Weather Bureau, Washington, D. C., on seventy-fifth meridian time.

TABLE 1.—*Earthquake of May 9, 1905, N-S. component.*

	h.	m.	s.
First preliminary tremors began	2	53	42 a. m.
Principal portion began	2	57	32 a. m.
Principal portion ended	2	58	48 a. m.
End of earthquake	3	15	52 a. m.
Duration of first preliminary tremors	3 min.	50 sec.	
Duration of principal portion	1 "	16 "	
Total duration of earthquake	22 "	10 "	
Period of pendulum			28 sec.
Maximum double amplitude of actual displacement of the earth at the seismograph			0.1 mm.
Magnification of record			10 times.

This earthquake was too small and feeble to fully develop all the usual characteristics of such records.

TABLE 2.—*Earthquake of July 9, 1905, N-S. component.*

	h.	m.	s.
First preliminary tremors began	5	4	35 a. m.
Second preliminary tremors began	5	22	7 a. m.
Principal portion began	5	33	42 a. m.
Principal portion ended (not well defined)	5	46	27 a. m.
End of earthquake	6	34	25 a. m.
Large waves in second preliminary tremors	5	30	7 a. m.

TABLE 2.—*Earthquake of July 9, 1905, N-S.*—Continued.

Duration of first preliminary tremors	17 min.	32 sec.	
Duration of second preliminary tremors	11 "	35 "	
Duration of principal portion	12 "	45 "	
Total duration of earthquake	1 hr. 29 "	50 "	
Average complete period of seven waves in second preliminary tremors			30 sec.
Average complete period of large waves of principal portion			20 to 30 "
Period of pendulum			27 sec.
Maximum double amplitude of actual displacement of the earth at the seismograph			0.81 mm.
Magnification of record			10 times.

The waves are very complex in the principal portion and die away very gradually so that the beginning of the "end portion" is not sharply defined.

TABLE 3.—*Earthquake of July 22–23, 1905, N-S. component.*

	h.	m.	s.	
First preliminary tremors began	10	10	13	p. m.
Second preliminary tremors began	10	25	33	p. m.
Principal portion began	10	39	00	p. m.
Principal portion ended	10	59	00	p. m.
End of earthquake, a. m. July 23	0	21	30	p. m.
Duration of first preliminary tremors	15 min.	20 sec.		
Duration of second preliminary tremors	13 "	27 "		
Duration of principal portion	20 "	00 "		
Total duration of earthquake	2 hr. 11 "	17 "		
Period of pendulum			26 sec.	
Maximum double amplitude of actual displacement of the earth at the seismograph			5.40 mm.	
Magnification of record			10 times.	

Largest earthquake yet recorded.

TABLE 4.—*Earthquake of July 22–23, 1905, E-W. component.*

	h.	m.	s.	
First preliminary tremors began	10	11	00	p. m.
Second preliminary tremors began	10	24	00	p. m.
Principal portion began	10	30	40	p. m.
Principal portion ended	10	53	00	p. m.
End of earthquake, a. m., July 23	0	46	15	p, m.
Duration of first preliminary tremors	13 min.	00 sec.		
Duration of second preliminary tremors	6 "	40 "		
Duration of principal portion	22 "	20 "		
Total duration of earthquake	2 hr. 35 "	15 "		
Period of pendulum			30 sec.	
Maximum semiamplitude of actual displacement of the earth at the seismograph (to the west)			5.4 mm.	
Magnification of record			13.2 times.	

The pen went off the sheet to the east three times, viz, more than five millimeters, hence actual displacement exceeded eleven millimeters.

A critical examination of the wave motions as they are found recorded in the various records thus far obtained has led us to the opinion that the so-called steady mass of the seismograph fails to remain at rest as completely as it is generally supposed to do. In other words the motion of the earth soon sets the "steady mass" itself to swinging more or less, so that the trace finally resulting from the two movements is not a faithful record of the motions of the earth. The problem of completely separating the one motion from the other is very complex and difficult, and a full analysis has not thus far been brought out. Some notes presenting an approximate method of analysis have recently been employed and the results obtained will be given in a future communication to the REVIEW.

TIDES AND THUNDERSTORMS.

By JOHN C. BEANS, Cooperative Observer, Moorestown, N. J.

A recent circular requesting observations on the course of thunderstorms reminds me of certain articles and communications in the MONTHLY WEATHER REVIEW during the past year and the strong inclination I felt at those times to send in a communication disparaging the idea of perceptible inductive influence of tidal currents on atmospheric vapors, nay, on air currents too and whole thunderstorms as suggested.

Some years ago my father was a considerable grower of strawberries, employing some forty pickers daily. Many of these came from the village of Bridgeboro, then a considerable sailing packet port on the Rancocas two or three miles from the Delaware, but doing business several miles farther up, chiefly to Philadelphia. Navigating these sloops and schooners against wind and tide on rather narrow and crooked streams and between showers, if possible, developed in the captains and hands of these craft an alertness and shrewdness in observing the ways of the weather, probably not yet excelled, except by the educated part of the weather service. They would look at a possible coming shower, observe the state of the tide, and remark that if the tide was running up, the shower would go up the Delaware River, but if the tide was running down the shower might be expected to go up the Rancocas Creek, and we would get some. Ever since then showers have continued going sometimes in line with the Delaware, sometimes with the Rancocas, sometimes elsewhere. Those pickers generally knew the state of the tide, for two or three of the packets usually sailed past them daily. I can now see approximately the stage of the tide from my home, but I do not keep in mind its course and have not always a Public Ledger Almanac. However, with a farmer's need of rain lore, I have been watching showers (and for showers) these 35 years, but have not seen any four-times-a-day changeableness in the course of showers, nor any other changeableness that the tidal theory might lead to. The course of showers has often been with that of middle clouds when such appear. Did these old navigators of Delaware Bay get their theory from their fellow craftsmen, the farmers of Cape May County, and expect it to apply to all streams?

HAS THE RAINFALL OF SOUTHERN CALIFORNIA BEEN AFFECTED BY ANY SO-CALLED RAINMAKER?

During the discussion in southern California in April, 1905, over the merits of an individual calling himself a rainmaker, there was sent out by the Associated Press a general news despatch that seems to show there are a few believers in the supernatural still left over to this enlightened age. It behooves the press, as the leader of public opinion, to do what it can to enable the public to appreciate the influence of man on the weather.

From Los Angeles to San Bernardino is an eastward stretch of 75 miles; the railroad runs from the Pacific coast eastward along the southern slope of the San Gabriel, Cucamonga, and San Bernardino ranges of mountains. Los Angeles is about twenty miles east and also twenty miles north of the curved coast line. Pasadena is ten miles northeast of that and Altadena five miles north of that. The new Solar Observatory of the Carnegie Institution is on Mount Wilson near Pasadena. This whole region is a garden under the latitude of 34° north receiving moderate winter rains and an abundance of sunshine and needing only a wise supervision of the irrigation ditches to produce the most beautiful and profitable tropical plantations. The photographs reproduced in the MONTHLY WEATHER REVIEW for November, 1903, give a fair idea of the character of this garden spot. The general details as to orography may be seen in the relief map published in Bulletin L, Climate of California, by Prof. A. G. McAdie. It is easily understood by the meteorologist that northerly winds coming over the mountain ranges will bring dry and dusty weather, clear sky, hot days, and cool nights. Southerly winds, especially southwest winds, will push moist ocean air up the mountain slopes and give cloud and local rains to the southern slopes. Further details and tables of rainfall are given by Professor McAdie in the above-mentioned bulletin. In such a climate all vegetation depends on the rainfall of the winter season and the monthly

tabular values of rain should be summed up from October to May continuously if we would know how much water is available for the regular annual crop or what are the important annual and secular variations of rainfall as was shown by the Editor in the MONTHLY WEATHER REVIEW for January, 1904, page 24.

On the other hand, when any one deceives himself or the community into the silly belief that he has been able to increase or diminish the rainfall by his own personal acts, we are able to quote the records of many past years showing that the rainfall has always had a certain amount of variability and that his rainmaking experiments have not produced any effect as to rain or drought that is contrary to the natural and well established order of events.

The tables on page 77 of Bulletin L give the rainfall measured at the Weather Bureau station at Los Angeles since 1877 for each winter season, viz, from September 1 to September 1; the following copy has been corrected and extended throughout the later years by the official in charge of the Records Division at the Central Office, Washington, D. C.:

12 months beginning September 1.	Rainfall, in inches.	12 months beginning September 1.	Rainfall, in inches.
1877	21.26	1891	11.86
1878	11.35	1892	26.27
1979	20.34	1893	6.74
1880	13.13	1894	16.10
1881	10.40	1895	8.54
1882	12.11	1896	16.83
1883	38.26	1897	7.13
1884	9.25	1898	5.53
1885	23.18	1899	7.90
1886	14.01	1900	16.38
1887	14.16	1901	10.51
1888	9.57	1902	19.32
1889	34.60	1903	8.89
1890	13.33	1904	19.35

From this we see that in the course of 28 successive seasons at Los Angeles there have occurred—

6 having a rainfall of 20 inches or more.
6 having a rainfall of 15 to 19 inches.
9 having a rainfall of 10 to 14 inches.
7 having a rainfall of 9 inches or less.

This table shows that wet seasons are as frequent as dry ones. In nearly every case a dry season is followed by a wet one. A rainmaker discharging mysterious gases into the air daily from September to May will have no right to claim that he has power to compel or induce rain until he can show that he has done better than unaided nature is herself doing for the place where he operates.

The proper statistical method of argumentation is illustrated in the following extract from the Daily Times of Los Angeles, Cal., April 23, 1905.

I note, says Dr. Garrett Newkirk of Pasadena, that a certain gentleman who appears to imagine that he has had something to do with the making of rain in southern California, by means of some sort of chemicals or gaseous exploitation upon the patient atmosphere, is advertised to give a series of lectures in Los Angeles and elsewhere, telling how he did it.

It is hard to understand how anyone with a modicum of sense and the statistics of rainfall before him could suppose for a moment that southern California has had a drop more or less of rain because of that little black box on the side hill at Esperanza. We have had so far at the Los Angeles observatory some eighteen or nineteen inches of rain for the season of 1904–5. On and near the mountains, as usual, there may have been a few inches more. We have not had a remarkable rainfall, nothing, in fact, unusual, except that on two occasions the storms were violent on the mountain slopes, causing floods in certain parts of the valley.

Why do people insist on forgetting that only two years ago we had a greater rainfall for the season than we have had so far this year.

Leaving out the three dry years, the average rainfall by standard measurement has been 16.49 inches since the year 1877, so that the amount this season has not been more than two or three inches above the general average. The three dry years made such a deep impression on the minds of those who lived through them, that they have been over sensitive and apprehensive of drought ever since. In the good years of 1900–1901 and 1902–3 the showers were evenly distributed through their seasons, with much of sunshine between. Jupiter Pluvius was in gentle mood. No water went to waste. But people were not fully impressed. This year, with a deluge once or twice repeated, all their hands went up. It is safe to say that more water went into the ground two years ago than in this season of impressive storms.

The influences governing our rainfall extend over great regions and distances – north to the polar wastes, east to mountain and desert, south and west thousands of miles over the illimitable waters of the sea. For thousands of years, no doubt, the changing seasons came to the region where we dwell, before Columbus crossed the sea or the modest Balboa stepped into the Pacific and "took possession" of all the land touched by its waters. The average rain of a hundred years might be a bit more or less than that of the last 25, but of this we are reasonably sure that in each century of time there will be somewhere about 1600 inches quite irregularly distributed year by year.

METEOROLOGICAL RECORDS AT ORONO, ME.

By Prof. JAMES S. STEVENS. Dated Orono, Me., February 1, 1905.

The following is a continuation of an article on the meteorology of Orono, on the Penobscot River near Bangor, Me.; the section on barometry was published in the MONTHLY WEATHER REVIEW for April, 1904.

2. *Thermometry.*—Temperature observations began to be made by Dr. M. C. Fernald, January 1, 1869. From this date to January 1, 1893, observations were made three times a day, at 7 a. m., 2 p. m., and 9 p. m. In Table 3 the mean of these observations is found by assigning to the 9 p. m. observations

* TABLE 3.—*Monthly mean temperatures at Orono, Me., based on tridaily observations.*

Year.	January.				February.				March.			
	7 a.m.	2 p.m.	9 p.m.	Mean.	7 a.m.	2 p.m.	9 p.m.	Mean.	7 a.m.	2 p.m.	9 p.m.	Mean.
1869	16.6	23.1	18.8	18.4	16.5	27.3	21.6	21.8	18.5	30.6	23.9	24.2
1870	19.2	27.2	21.9	22.6	14.1	26.3	18.0	19.1	22.0	34.2	27.9	28.0
1871	12.6	18.2	16.0	15.7	15.2	25.8	21.2	21.0	30.5	39.6	34.3	34.7
1872	13.8	20.2	15.9	16.5	9.1	26.1	18.7	18.2	12.6	25.8	19.5	19.4
1873	9.7	20.1	15.1	15.0	8.5	22.8	17.4	16.5	21.5	32.6	27.6	27.4
1874	15.3	23.6	19.0	19.2	11.5	23.5	17.5	17.5	22.1	33.2	27.4	27.5
1875	1.1	14.6	9.0	8.4	8.1	18.9	13.5	13.5	18.2	30.4	24.9	24.6
1876	14.5	23.6	18.0	18.5	14.3	24.4	18.2	18.8	22.3	33.2	28.5	28.1
1877	2.8	16.3	9.1	9.3	19.8	31.8	26.1	25.9	24.2	34.1	27.7	28.4
1878	13.1	22.6	16.9	17.4	14.4	30.2	23.1	22.7	27.8	37.3	33.3	32.9
1879	8.1	19.8	13.3	15.6	8.1	23.1	16.8	16.2	21.9	33.4	28.1	27.9
1880	13.5	28.7	21.6	21.4	17.2	28.6	22.8	22.9	20.6	31.6	26.3	26.2
1881	8.7	20.0	12.7	12.2	16.8	28.4	22.9	22.8	30.9	36.2	34.1	33.8
1882	10.7	22.6	16.3	16.5	14.8	28.8	21.9	22.0	23.3	34.3	29.6	29.2
1883	4.1	17.4	11.7	11.2	11.3	23.7	17.2	17.4	15.7	27.7	21.5	21.6
1884	5.2	19.0	14.4	13.3	18.0	27.5	22.2	22.5	20.2	33.2	27.4	27.1
1885	11.1	21.2	15.6	15.9	3.0	21.4	15.3	13.8	11.3	26.6	19.3	19.1
1886	13.9	22.6	18.1	18.2	11.9	23.7	19.5	18.7	20.4	33.1	27.8	27.3
1887	9.5	18.4	14.4	14.2	12.3	22.8	17.1	17.4	20.7	32.3	25.3	25.9
1888	4.7	14.7	8.4	9.1	12.7	25.0	19.5	19.2	22.6	32.6	28.2	27.9
1889	20.6	28.6	24.9	24.8	9.5	19.0	16.1	15.2	27.7	39.5	33.0	33.3
1890	11.9	21.7	18.3	17.6	18.7	28.0	22.1	22.7	22.9	34.9	29.0	28.9
1891	15.8	25.6	20.9	20.8	19.4	27.7	22.7	23.1	23.9	34.9	28.3	28.9
1892	18.0	26.4	22.2	22.2	15.4	30.1	22.5	22.6	20.1	33.3	27.7	27.2
Mean...	11.4	21.5	16.4	16.5	13.2	25.6	19.7	19.5	21.3	33.1	27.5	27.9

Year.	April.				May.				June.			
1869	35.3	45.1	38.2	39.2	45.1	59.2	48.8	50.5	.....	.....	.....	.....
1870	37.5	51.9	41.9	43.3	46.9	60.6	48.8	52.0	61.5	74.5	62.0	65.0
1871	36.1	46.8	40.1	40.8	44.9	58.4	48.2	49.9	57.7	70.2	58.6	61.3
1872	34.7	47.4	38.6	39.8	48.7	57.9	49.8	51.6	59.9	71.6	61.3	63.5
1873	35.4	45.4	37.8	39.1	47.9	61.1	48.7	51.6	55.5	69.2	57.5	59.9
1874	29.0	38.8	32.1	33.0	46.8	59.7	49.1	51.2	65.4	66.7	58.4	59.7
1875	31.7	43.2	34.8	36.1	47.2	59.6	49.5	51.8	56.8	68.9	57.8	60.3
1876	34.5	45.6	37.8	38.8	46.0	58.0	47.8	49.9	60.8	73.6	61.8	64.5
1877	37.4	51.3	41.8	43.1	47.7	61.6	50.5	52.6	60.3	72.0	60.2	63.2
1878	40.4	51.4	42.8	44.4	50.4	61.2	52.4	54.1	57.9	70.7	58.6	61.5
1879	33.5	45.2	37.0	38.2	50.8	65.4	52.7	55.0	57.1	66.0	57.1	59.3
1880	36.1	47.7	38.5	40.2	51.7	55.4	53.9	56.2	60.6	71.0	60.5	63.2
1881	33.3	46.7	39.2	39.6	47.7	59.9	51.5	52.7	54.4	68.1	55.4	58.3
1882	32.2	41.8	35.6	36.3	44.9	57.2	47.7	49.4	59.2	70.1	60.1	62.4
1883	34.5	45.9	37.6	38.9	47.0	59.6	50.5	51.9	62.6	72.3	61.3	64.4
1884	38.7	48.6	41.5	42.6	47.4	57.4	47.7	50.0	60.6	74.5	61.8	64.7
1885	35.8	48.9	39.1	40.7	47.7	61.5	49.3	51.9	58.9	69.6	59.3	61.8
1886	38.3	52.5	41.5	43.5	49.5	62.3	50.9	53.4	59.7	70.0	57.9	61.4
1887	32.3	44.4	36.7	37.5	47.7	64.6	53.0	54.6	59.9	70.9	59.7	62.6
1888	33.1	44.3	36.3	37.5	46.9	59.0	48.8	50.9	60.8	70.2	60.0	62.8
1889	40.2	53.4	43.3	45.1	52.7	66.8	53.0	56.4	62.9	72.5	62.1	64.9
1890	35.3	47.9	38.8	40.2	49.3	59.4	50.6	52.5	57.8	66.6	57.2	59.7
1891	37.7	47.9	40.1	41.4	47.1	60.6	50.2	52.0	57.6	69.1	58.0	60.8
1892	37.8	52.9	41.0	43.2	48.0	58.4	49.9	51.6	58.3	71.7	61.0	63.0
Mean...	35.4	47.3	38.8	40.1	47.9	60.2	50.0	52.3	59.0	70.9	59.4	62.1

* The numbers of these tables are in continuation of the previous article in MONTHLY WEATHER REVIEW for April, 1904.

TABLE 3.—*Monthly mean temperatures at Orono, Me.*—Continued.

Year.	July.				August.				September.			
	7 a.m.	2 p.m.	9 p.m.	Mean.	7 a.m.	2 p.m.	9 p.m.	Mean.	7 a.m.	2 p.m.	9 p.m.	Mean.
1869	62.0	74.6	63.9	66.1	57.2	70.9	59.8	61.9	54.9	67.7	56.8	59.1
1870	64.3	77.7	65.3	68.2	61.1	77.6	63.3	67.6	51.3	66.8	56.0	57.5
1871	62.4	75.4	64.0	66.5	59.9	74.7	63.4	65.4	48.0	63.0	52.6	54.1
1872	64.2	76.9	65.8	68.2	62.7	75.4	64.8	66.9	54.7	64.7	56.7	58.2
1873	64.3	76.8	64.3	67.4	58.4	72.4	60.2	65.8	50.1	63.8	52.9	54.9
1874	62.5	73.5	64.4	66.2	57.7	71.2	60.7	62.6	53.1	66.0	55.9	57.7
1875	52.7	74.6	63.2	65.9	62.3	76.9	65.4	67.5	48.7	61.5	52.3	53.7
1876	66.9	75.6	65.7	68.3	61.5	76.8	64.5	66.8	49.4	63.1	52.8	54.5
1877	64.0	75.6	65.2	67.5	62.7	75.0	65.0	66.9	52.5	70.1	57.6	59.5
1878	65.9	75.8	65.8	68.3	61.5	73.6	62.7	65.1	55.3	67.5	57.3	59.4
1879	63.9	75.4	63.5	66.6	59.3	73.1	62.3	64.3	52.2	63.7	54.8	56.4
1880	65.3	77.6	66.8	69.1	61.0	74.0	63.2	65.4	55.3	68.5	59.1	60.5
1881	63.3	73.6	64.5	65.8	64.1	76.1	65.9	68.0	55.8	68.1	59.1	60.5
1882	67.1	76.4	65.5	68.6	62.2	78.2	65.0	67.9	53.8	63.8	55.1	57.0
1883	61.3	71.8	63.6	65.1	60.2	75.0	61.6	64.6	49.7	69.3	54.8	57.2
1884	61.8	72.4	62.2	64.7	62.9	74.2	64.2	66.4	53.4	67.6	57.0	58.8
1885	65.1	75.2	64.9	67.5	58.9	71.8	61.1	63.2	49.5	63.8	52.5	54.6
1886	64.9	75.7	63.9	67.1	58.2	75.0	62.9	64.8	51.1	64.5	54.5	56.2
1887	69.0	78.3	68.2	70.9	59.9	71.0	60.9	63.2	49.5	64.5	55.1	56.1
1888	62.2	75.0	62.6	65.6	60.1	70.9	61.5	63.5	50.2	62.1	52.3	54.2
1889	63.9	74.8	63.8	66.6	61.2	73.1	62.2	64.7	55.3	67.3	59.3	60.3
1890	64.2	74.5	63.1	66.2	61.3	73.3	62.4	64.9	53.9	65.1	56.9	58.2
1891	62.7	75.0	61.0	64.9	62.2	73.7	64.3	66.1	55.4	69.0	58.9	60.6
1892	63.5	77.6	65.5	68.0	61.3	73.0	64.5	65.8	52.7	67.5	57.0	58.5
Mean	63.6	75.4	64.4	67.0	60.7	74.0	62.9	65.4	53.1	65.8	55.8	57.0

Year.	October.				November.				December.			
1869	41.4	52.8	43.4	45.3	28.1	37.0	32.2	32.4	.....	.....	.....	.....
1870	42.4	54.4	49.0	48.7	33.8	41.4	34.9	36.3	22.0	28.4	23.4	24.3
1871	43.3	54.2	46.4	47.6	25.9	33.6	27.7	28.7	15.1	21.2	15.9	16.5
1872	40.8	52.6	43.7	45.2	30.8	37.9	32.7	33.5	9.7	18.3	12.5	14.3
1873	41.5	54.9	45.7	47.0	22.1	29.6	23.9	25.0	14.7	25.3	20.3	20.2
1874	42.1	55.8	45.9	47.4	28.5	38.1	31.7	32.5	13.5	23.1	18.3	18.3
1875	39.9	48.8	42.2	43.3	23.0	31.6	26.9	27.1	13.6	23.5	18.6	18.6
1876	38.3	49.2	41.7	42.8	32.2	40.3	34.9	35.8	7.3	20.1	13.0	13.3
1877	38.2	49.3	43.4	43.6	34.0	42.7	36.9	37.8	21.4	31.7	26.0	26.3
1878	44.5	56.5	48.3	49.4	31.5	38.9	33.0	34.1	21.8	27.8	26.0	25.4
1879	46.2	57.5	48.4	50.1	30.6	38.2	33.4	33.9	16.2	24.9	18.9	19.7
1880	42.5	54.9	45.7	47.2	26.6	37.6	30.5	31.4	14.0	26.2	20.6	20.4
1881	43.3	52.6	43.9	45.9	31.7	40.2	35.8	35.9	28.1	34.8	30.1	30.8
1882	42.5	57.9	45.1	47.7	30.4	39.7	32.2	33.6	14.1	25.8	19.5	19.7
1883	38.5	50.7	41.3	43.0	31.1	40.9	34.0	35.0	16.7	27.2	20.0	21.0
1884	39.0	51.9	44.2	44.8	29.3	38.7	33.3	33.7	20.5	28.8	23.0	23.8
1885	42.5	53.7	45.3	46.7	32.1	41.6	35.9	36.1	19.1	28.2	23.1	24.4
1886	39.1	54.9	44.0	45.5	34.1	42.2	36.9	37.5	14.0	22.6	18.0	18.2
1887	38.0	49.2	42.9	43.3	31.1	39.2	33.2	34.2	20.9	28.3	22.3	23.5
1888	39.3	46.5	41.4	42.2	32.0	41.1	33.5	35.0	25.5	31.7	27.4	28.0
1889	39.0	51.4	41.4	43.3	33.7	44.7	37.7	38.5	24.3	31.4	27.0	27.4
1890	40.0	53.2	44.3	45.4	31.7	40.2	32.5	34.7	7.6	16.8	11.3	11.8
1891	40.0	53.0	44.2	45.4	32.1	42.6	39.2	38.3	27.1	37.1	32.0	32.2
1892	40.2	53.1	44.0	45.3	35.3	41.1	35.8	36.8	16.8	26.9	21.0	21.4
Mean	40.9	52.9	44.3	45.7	30.4	39.1	33.2	34.5	20.1	26.5	21.2	21.7

a double weight. Beginning with 1893 the maximum and minimum temperature for each 24 hours were recorded. Table 4 shows the maximum and minimum for each month. The thermometer used from 1869 to 1893 was a Huddleston, since that time a Green. The location was changed in June, 1879, and about January, 1893.

In Table 4, 1893–1904, the data for mean maximum and

TABLE 4.—*Monthly and absolute extremes and monthly mean temperatures.*

Year.	January.					February.				
	Absolute max.	Absolute min.	Mean max.	Mean min.	Mean monthly.	Absolute max.	Absolute min.	Mean max.	Mean min.	Mean monthly.
1893	51.2	—20.3	.....	.....	12.5	48.	—14.4	.....	.....	17.2
1894	45.6	—32.0	.....	.....	17.9	42.5	—29.5	.....	.....	12.9
1895	.....	.....	.....	.....	.....	41.	—10.1	.....	.....	17.5
1896	.....	.....	.....	.....	.....	43.	—30.	.....	.....	24.1
1897	52.	—18.	28.0	5.0	17.4	43.	—16.	31.6	8.1	20.2
1898	40.	—30.	24.6	2.2	13.2	47.	—25.	33.9	15.4	24.3
1899	49.	—29.	26.8	3.7	16.0	52.	—16.	25.1	7.4	16.5
1900	46.	—19.	31.2	4.5	17.8	50.	—21.	31.6	9.4	20.5
1901	42.	—20.	23.7	6.8	15.0	40.	—18.	24.9	3.1	14.2
1902	47.	—16.	26.8	7.7	17.3	52.	—15.	31.7	11.4	22.1
1903	41.	—23.	24.6	6.9	15.7	50.	—16.	28.8	10.8	19.2
1904	41.	—26.	21.8	—1.1	10.3	43.	—26.	23.7	0.8	12.3
Mean	45.5	—23.3	26.0	4.9	15.3	45.9	—19.8	28.9	8.3	18.4

TABLE 4.—*Monthly and absolute extreme, etc.*—Continued.

Year.	March.					April.				
	Absolute max.	Absolute min.	Mean max.	Mean min.	Mean monthly.	Absolute max.	Absolute min.	Mean max.	Mean min.	Mean monthly.
1893	47.4	0.6	.....	.....	27.1	59.2	13.0	.....	.....	37.8
1894	63.3	8.2	.....	.....	32.0	77.4	12.3	.....	.....	42.0
1895	47.0	— 3.5	.....	.....	26.9	69.0	12.0	.....	.....	42.9
1896	43.0	— 7.0	.....	.....	24.3	.....	18.0	.....	.....	42.7
1897	48.	—11.	36.1	18.5	28.4	74.	14.	52.4	32.2	41.8
1898	60.	5.	45.3	21.5	32.2	65.	9.	48.6	30.6	38.8
1899	51.	— 3	34.3	17.6	26.5	84.	18.	56.7	31.8	43.3
1900	52.	—10.	39.1	14.0	26.6	78.	21.	56.2	32.0	44.1
1901	49.	—13.	36.7	18.3	27.7	76.	25.	53.5	35.6	44.7
1902	62.	2.	45.2	28.5	36.9	75.	27.	53.7	33.1	43.4
1903	64.	0.	47.4	27.7	37.5	76.	18.	55.7	30.9	43.0
1904	51.	— 7.	39.5	18.4	29.0	62.	16.	52.4	29.6	41.0
Mean	53.1	— 2.4	40.9	20.6	27.8	72.3	16.9	53.6	32.0	42.1

Year.	May.					June.				
1893	82.4	31.0	.....	.....	53.7	84.0	39.1	.....	.....	64.0
1894	84.9	30.0	.....	.....	52.4	88.0	37.0	.....	.....	60.9
1895	89.0	31.0	.....	.....	55.1	91.0	37.0	.....	.....	64.8
1896	.....	21.0	.....	.....	53.3	.....	.....	.....	.....	.....
1897	76.	29.	62.0	43.0	52.1	83.	39.	67.5	46.4	57.0
1898	76.	28.	64.7	43.0	53.1	87.	36.	71.1	51.1	61.5
1899	80.	26.	64.6	40.1	52.3	87.	37.	73.9	50.0	62.1
1900	83.	26.	63.0	39.5	49.5	86.	38.	77.4	49.4	63.4
1901	85.	32.	64.5	42.9	53.9	91.	38.	74.9	52.2	63.8
1902	83.	28.	61.2	40.2	50.6	84.	34.	67.4	46.2	56.8
1903	83.	26.	69.4	39.5	54.4	81.	32.	73.3	47.4	60.4
1904	82.	29.	71.6	44.7	58.1	87.	38.	73.7	48.0	60.8
Mean	82.2	28.1	65.1	41.8	53.2	86.3	36.8	72.4	48.8	61.4

Year.	July.					August.				
1893	89.5	46.1	.....	.....	66.7	95.0	46.7	.....	.....	65.8
1894	93.8	44.5	.....	.....	66.9	86.8	35.9	.....	.....	61.6
1895	89.0	43.0	.....	.....	64.5	86.0	41.0	.....	.....	64.1
1896	86.0	55.0	.....	.....	66.0	92.0	39.	75.0	54.0	64.7
1897	93.	43.	79.0	57.0	66.6	85.	41.	74.0	53.0	64.2
1898	99.	39.	79.5	57.6	68.3	85.	41.	78.3	56.7	67.3
1899	91.	41.	77.0	59.6	68.4	93.	40.	78.1	54.8	66.5
1900	89.	47.	79.8	56.4	68.1	.....	.....	.....	.....	66.3
1901	100.	40.	80.2	56.6	68.6	86.	43.	76.9	55.9	66.7
1902	87.	43.	75.3	53.0	64.7	85.	39.	74.4	51.8	63.1
1903	88.	34.	77.9	46.2	62.1	81.	38.	73.6	47.7	60.5
1904	87.	46.	80.4	57.2	68.8	88.	40.	76.6	51.8	64.6
Mean	91.9	43.5	78.4	55.5	66.6	87.3	40.4	75.9	53.2	64.6

Year.	September.					October.				
1893	71.8	30.7	.....	.....	52.3	72.0	25.5	.....	.....	47.9
1894	89.6	27.0	.....	.....	61.3	66.0	27.0	.....	.....	46.1
1895	92.5	26.5	.....	.....	56.6	73.9	13.0	.....	.....	42.9
1896	87.	28.	65.0	46.0	53.8	68.	23.	53.0	37.0	44.7
1897	90.	28.	68.0	42.0	56.2	79.	19.	60.0	34.0	46.9
1898	85.	29.	70.7	45.9	58.6	86.	19.	57.6	36.0	47.2
1899	88.	23.	67.9	45.3	56.6	76.	22.	62.2	37.7	50.0
1900	93.	27.	72.2	46.2	59.2	76.	19.	60.9	41.8	51.4
1901	89.	28.	71.1	47.7	59.5	71.	20.	58.0	36.4	47.6
1902	82.	30.	69.4	48.7	59.5	75.	17.	56.7	37.8	47.3
1903	89.	29.	74.0	46.5	60.2	71.	22.	57.8	36.4	47.1
1904	80.	26.	67.5	43.6	55.5	69.	20.	55.1	36.3	46.1
Mean	86.4	27.7	69.5	46.0	58.3	73.5	20.5	57.9	33.7	47.1

Year.	November.					December.				
1893	57.4	9.3	.....	.....	33.7	40.2	—22.0	.....	.....	14.3
1894	59.0	— 5.0	.....	.....	34.5	43.5	— 7.0	.....	.....	22.4
1895	71.0	10.0	.....	.....	36.9	.....	.....	.....	.....	.....
1896	68.	— 4.	32.8	25.9	34.6	45.	— 9.	29.0	10.0	20.0
1897	59.	3.	41.0	25.0	33.8	51.	—11.	30.4	15.9	23.3
1898	55.	10.	42.7	28.7	36.3	43.	—13.	29.6	11.8	21.4
1899	58.	8.	43.4	24.6	34.0	57.	— 9.	37.4	18.7	28.0
1900	72.	9.	42.6	28.6	35.6	45.	—16.	23.0	81.1	15.6
1901	58.	— 8.	37.3	20.0	28.6	55.	—17.	31.9	14.5	23.3
1902	58.	18.	46.0	28.3	37.2	53.	—28.	25.9	8.7	17.1
1903	70.	2.	43.7	23.9	33.8	50.	—10.	30.0	10.0	20.0
1904	50.	0.	39.7	21.1	30.5	39.	—27.	22.5	1.1	11.9
Mean	61.3	5.0	41.0	25.1	34.1	47.6	—14.7	28.8	11.0	19.7

mean minimum do not appear for the years 1893–1896: the mean monthly temperature for these years is the mean of the

tridaily readings, or ¼ (7+2+9+9). The monthly means for each hour have not been preserved. For 1897–1904 the mean monthly temperature is the mean of the mean maximum and the mean minimum. Records at 2 p. m. only were taken in this period.

Table 5 gives, in the second column, the average temperature for each month for the period of 24 years (1869 to 1892, inclusive), and in the third column the average temperature for 35 years (1869 to 1904, inclusive), also the highest and lowest mean temperature during the whole period (1869 to 1904):

TABLE 5.—*Mean and extreme monthly temperatures.*

Month.	Average for 24 years.	Average for 35 years.	Highest temperature.		Lowest temperature.	
			Degrees.	Year.	Degrees.	Year.
January	16.11	16.0	57.8	1890	−35.6	1878
February	19.33	19.2	52.0	1899	−30.0	1896
March	27.37	28.1	63.3	1894	−22.0	1869
April	40.56	40.6	84.0	1899	1.0	1874
May	52.17	52.4	90.0	1880	21.0	1896
June	62.18	61.8	98.5	1878	32.0	1903
July	67.16	67.1	100.0	1901	34.0	1903
August	65.09	64.9	96.7	1876	35.0	1873
September	57.12	57.3	93.0	1900	23.0	1899
October	45.61	46.1	86.0	1898	13.0	1895
November	35.22	34.2	72.0	1900	−16.2	1875
December	21.57	21.3	60.6	1888	−36.3	1890

3. *Vapor tension and relative humidity*.—In Tables 6 and 7 are given the vapor tension and the relative humidity at 7 a. m., 2 p. m., and 9 p. m., for 1869–1875, inclusive. From 1869–1875 the relative humidity was recorded at 7 a. m., 2 p. m., and 9 p. m., and the mean taken.

The hygrometer used throughout was of the Huddleston type and was furnished by the Weather Bureau.[1]

TABLE 6.—*Mean vapor pressure.*

Year.	January.			February.			March.			April.		
	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.
1869	.081	.099	.096	.078	.104	.100	.083	.112	.101	.172	.188	.177
1870	.101	.111	.112	.084	.104	.090	.100	.107	.106	.190	.218	.209
1871	.074	.087	.099	.083	.096	.097	.150	.166	.161	.177	.190	.194
1872	.084	.002	.084	.066	.091	.088	.076	.092	.089	.152	.165	.169
1873	.079	.093	.087	.067	.082	.087	.106	.121	.127	.160	.164	.167
1874	.100	.123	.114	.078	.089	.090	.101	.117	.118	.126	.138	.134
1875	.044	.063	.062	.070	.089	.086	.091	.103	.108	.131	.141	.143

Year.	May.			June.			July.			August.		
	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.
1869	.262	.285	.289	.....	.....	.....	.474	.520	.491	.397	.405	.417
1870	.256	.267	.268	.467	.506	.465	.496	.497	.505	.470	.480	.459
1871	.239	.243	.238	.390	.411	.386	.487	.474	.485	.465	.476	.471
1872	.273	.288	.280	.445	.467	.463	.511	.522	.519	.517	.528	.545
1873	.242	.243	.250	.350	.343	.374	.505	.498	.487	.413	.418	.429
1874	.246	.262	.257	.374	.396	.402	.498	.528	.518	.436	.438	.466
1875	.249	.266	.257	.385	.445	.386	.500	.481	.488	.528	.572	.562

Year.	September.			October.			November.			December.		
	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.
1869	.405	.424	.417	.265	.280	.263	.144	.170	.171	.....	.....	.....
1870	.345	.372	.373	.265	.275	.274	.172	.179	.167	.112	.116	.114
1871	.313	.334	.332	.262	.282	.271	.125	.136	.134	.084	.095	.092
1872	.383	.408	.415	.249	.239	.254	.158	.163	.169	.071	.085	.076
1873	.325	.358	.354	.247	.273	.271	.108	.109	.109	.086	.105	.105
1874	.384	.428	.398	.243	.260	.259	.153	.162	.159	.084	.104	.091
1875	.325	.335	.346	.239	.232	.226	.120	.133	.135	.086	.096	.096

4. *Precipitation*.—In Table 8 are tabulated the precipitation records at Orono, Me., from 1869 to 1904, inclusive. They include the total precipitation, the total snowfall, the number of days with 0.01 inch or more precipitation, and the maximum in 24 hours, with the date on which maximum occurred.

Table 9 gives the days during the period in which the precipitation was 2.50 inches or over.

The rain gage was a Huddleston pattern during the first half of the observations, but one furnished by the U. S. Weather Bureau during the last half. They were well located in an exposed place, about 100 feet from the nearest building.

The scarcity of heavy rainfalls between 1896 and 1904 is noticeable.

TABLE 7.—*Relative humidity.*

Year.	January.			February.			March.			April.		
	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.
1869	83	72	80	76	68	77	72	60	68	80	64	76
1870	87	70	84	88	70	81	77	53	66	84	58	78
1871	85	71	85	82	59	75	84	65	78	81	60	77
1872	90	68	87	90	61	77	87	63	78	75	59	72
1873	86	75	88	87	61	81	86	63	80	78	53	74
1874	89	79	89	87	64	80	75	56	71	74	57	71
1875	83	69	86	84	70	83	78	55	74	74	50	66

Year.	May.			June.			July.			August.		
	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.
1869	83	56	81	.....	.....	.....	84	60	83	83	54	80
1870	78	51	75	85	59	83	81	53	80	85	53	77
1871	74	48	67	82	57	78	88	55	81	88	54	80
1872	79	61	78	85	61	84	84	57	80	89	61	88
1873	69	45	72	77	50	77	80	54	80	83	53	80
1874	73	48	71	83	61	79	88	65	86	89	57	86
1875	75	53	68	79	59	79	86	56	84	92	62	89

Year.	September.			October.			November.			December.		
	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.
1869	91	62	88	92	67	87	89	78	88	.....	.....	.....
1870	72	56	82	91	62	84	85	66	80	86	71	83
1871	89	47	81	87	60	81	86	66	82	87	75	89
1872	89	67	88	92	63	86	90	69	89	81	72	82
1873	85	60	84	89	61	83	83	64	79	87	68	86
1874	93	67	88	87	57	81	89	68	84	84	74	84
1875	89	61	85	88	65	81	88	70	85	88	67	85

TABLE 8.—*Precipitation.*

Year.	January.					February.				
	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.
1869	2.542	10.75	14	0.80	5	4.264	32.25	11	1.375	7
1870	5.615	26.0	14	1.29	2	4.296	15.0	12	1.89	19
1871	2.597	13.5	13	1.50	17	2.532	14.0	7	.873	18
1872	2.182	16.0	8	0.76	17	1.703	13.5	7	.978	4
1873	4.09	22.0	18	0.63	5	2.96	28.0	8	1.15	22
1874	4.57	25.0	16	1.45	8	5.50	40.0	13	2.85	4
1875	2.00	19.7	11	0.47	22	3.80	8.5	11	.85	25
1876	3.92	23.0	17	1.35	20	8.39	23.5	14	4.45	15
1877	3.29	28.5	14	0.80	16	1.20	10.5	7	.60	13
1878	5.08	15.0	15	1.80	11	2.41	14.0	7	1.40	25
1879	3.28	31.5	12	1.24	3	3.56	16.0	13	1.88	12
1880	2.83	13.0	14	0.94	22	2.83	16.5	15	.74	24
1881	2.08	16.5	8	0.83	10	3.35	13.5	13	1.15	12
1882	4.19	30.0	19	0.80	22	3.96	30.0	12	1.20	5
1883	2.44	15.0	13	0.60	31	2.34	13.0	13	.64	5
1884	4.44	17.5	9	2.04	9	6.85	26.5	20	1.27	23
1885	4.73	31.0	11	1.40	28	4.45	22.0	8	2.20	10
1886	6.64	37.0	17	3.40	31	5.42	32.0	12	2.60	28
1887	7.56	33.5	17	1.98	24	5.89	33.5	11	1.41	24
1888	4.97	37.5	12	1.60	27	6.11	20.5	12	2.26	20
1889	5.37	15.5	11	1.35	8	5.20	28.3	14	2.12	7
1890	3.33	19.5	17	1.25	16	4.57	13.0	14	1.45	8
1891	7.66	32.5	17	1.67	12	2.95	14.0	16	.56	3
1892	4.80	18.5	13	1.57	13	1.96	17.5	12	.85	12
1893	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1894	3.01	.....	2	2.0	30	1.73	15.0	2	.80	15
1895	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1896	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1897	3.08	23.3	7	1.0	28	2.38	9.5	5	1.38	7
1898	6.32	42.5	9	1.32	7	8.05	39.0	9	2.91	22
1899	2.75	10.0	5	1.25	6	2.27	13.5	7	.80	45
1900	8.14	26.3	10	1.98	12	6.75	23.0	10	1.94	13
1901	4.34	25.5	12	1.20	12	1.93	19.5	5	1.0	5
1902	3.65	13.0	10	1.73	22	1.80	18.0	8	.....	.....
1903	3.62	15.2	9	0.87	21	3.92	21.5	8	.74	12
1904	3.63	34.0	8	1.0	9	2.57	18.0	11	.62	22

[1] The Huddleston type is unknown to the Weather Bureau and the author must be mistaken in the belief that it was furnished by the Weather Bureau or the Signal Service. Nothing but the wet and dry bulb thermometers, or the so-called August psychrometer has ever been used by either of these services in regular station work. The only change was in 1887 when the psychrometer was mounted upon a whirling apparatus to secure better ventilation.—[ED.]

TABLE 8.—*Precipitation*—Continued.

Year.	March.					April.				
	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.
1869	3.356	10.42	9	.953	23	2.392	1.75	11	1.98	1
1870	2.114	10.50	12	.813	29	3.553	2.0	12	1.37	21
1871	4.108	8.0	13	2.01	22	4.01	1.0	15	.92	29
1872	5.234	38.0	14	1.80	10	1.33	3.0	11	1.10	10
1873	4.70	31.0	14	.80	30	2.39	5.0	11	.785	19
1874	3.40	14.0	10	1.45	4	3.76	30.0	16	1.15	30
1875	4.45	33.6	16	1.58	25	3.85	4.5	10	2.44	5
1876	8.20	18.0	14	3.25	21	1.65	9.0	13	.64	6
1877	5.67	11.0	17	2.50	29	3.18	.5	12	1.10	6
1878	2.73	8.0	13	.72	18	3.46	0.0	20	1.05	7
1879	3.40	18.5	14	.86	31	3.51	0.0	16	1.04	30
1880	2.86	18.0	10	1.24	24	4.15	2.0	13	1.98	30
1881	3.64	5.5	11	1.53	12	1.28	6.0	7	.92	15
1882	5.20	15.0	19	2.85	2	2.05	9.0	14	.75	20
1883	1.89	7.5	7	.72	28	3.80	2.5	12	1.27	20
1884	4.37	22.5	16	1.35	27	3.38	0.5	18	1.52	16
1885	2.78	15.0	10	1.08	2	2.34	3.5	13	.83	5
1886	2.87	22.0	10	1.22	22	1.80	1.0	7	1.42	7
1887	5.88	26.5	15	2.90	29	5.08	14.0	10	3.26	30
1888	6.48	26.0	20	1.62	29	1.78	16.0	14	.50	21
1889	4.62	4.0	12	2.90	9	1.93	4.0	8	.92	27
1890	5.81	3.6	15	1.25	3	2.02	6.0	9	.81	5
1891	5.20	12.0	10	1.60	10	3.26	11.0	13	1.25	3
1892	2.52	17.0	7	1.00	3	1.12	0.5	7	.42	10
1893	1.45	.....	7	.82	12	2.18	.....	13	.65	15
1894	1.23	2.5	10	.39	25	1.18	3.5	7	.35	9
1895	.....	1.6	.....	1.18	14	.....	.....	11	1.42	9
1896	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1897	3.96	6.5	12	.72	10	3.03	0.0	10	.84	9
1898	2.23	13.0	7	.70	31	4.95	9.0	12	2.19	19
1899	4.76	28.0	11	.90	16	0.66	.5	2	.55	8
1900	5.47	16.5	5	2.20	16	2.01	0.0	7	.62	19
1901	5.46	11.8	11	1.80	21	5.12	0.0	9	1.86	23
1902	8.89	14.	19	1.86	17	2.94	0.0	13	.84	10
1903	6.22	2.	11	1.26	8	1.71	0.5	5	.62	8
1904	3.18	12.	9	.74	8	2.31	3.5	10	.64	10

TABLE 8.—*Precipitation*—Continued.

Year.	July.					August.				
	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.
1869	1.62	0	12	.53	16	1.91	0	8	.84	28
1870	1.78	0	12	.44	29	3.21	0	6	2.42	4
1871	2.13	0	16	.50	31	3.85	0	8	1.66	27
1872	2.68	0	16	.37	19	6.23	0	15	1.37	17
1873	3.26	0	12	.67	27	1.81	0	6	1.13	3
1874	2.10	0	9	.95	3	5.39	0	9	4.20	9
1875	2.11	0	12	.33	7	2.32	0	11	.16	4
1876	5.80	0	17	2.50	24	.91	0	4	.46	25
1877	1.64	0	10	.80	26	5.28	0	15	2.30	10
1878	4.77	0	8	1.30	22	3.00	0	12	1.40	18
1879	5.79	0	12	2.45	23	5.66	0	10	4.80	19
1880	3.32	0	12	.60	24	1.54	0	8	1.00	4
1881	2.72	0	18	1.04	27	5.89	0	12	2.95	8
1882	3.10	0	11	.65	2	1.64	0	6	.85	15
1883	6.90	0	15	2.95	14	.53	0	5	.40	23
1884	2.38	0	15	.65	6	3.17	0	11	1.00	22
1885	4.70	0	14	1.52	31	7.36	0	11	2.85	6
1886	1.05	0	8	.48	16	2.27	0	11	1.12	17
1887	7.11	0	11	4.38	25	4.60	0	10	1.92	11
1888	2.47	0	11	.80	11	4.59	0	19	1.34	14
1889	3.23	0	10	1.12	20	1.65	0	12	.35	9
1890	3.84	0	11	1.23	8	4.55	0	17	1.28	20
1891	3.56	0	11	1.27	24	4.67	0	10	2.04	27
1892	1.99	0	9	1.40	4	6.42	0	12	2.80	12
1893	3.23	0	9	.88	3	.....	.....	.....	.....	.....
1894	2.41	0	6	1.16	24	2.01	0	6	1.28	3
1895	2.85	0	.....	.29	7	2.14	0	3	1.24	24
1896	2.58	0	.....	1.67	5	4.26	0	.....	.90	23
1897	2.02	0	9	.65	22	5.09	0	6	1.79	25
1898	2.44	0	5	.85	21	3.14	0	7	1.10	5
1899	4.49	0	10	2.00	21	.....	.....	.....	.....	.....
1900	2.53	0	9	1.34	25	1.58	0	9	.48	14
1901	2.75	0	11	1.15	30	3.76	0	8	2.06	25
1902	1.81	0	8	.40	8	4.96	0	10	2.45	11
1903	6.49	0	15	2.25	23	2.22	0	17	1.03	20
1904	2.43	0	10	.75	5	4.46	0	10	1.66	10

Year.	May.					June.				
	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.
1869	2.95	0.0	14	1.20	4	.....	.....	.....	.....	.....
1870	1.96	0.0	11	.49	11	2.07	0.0	6	1.75	9
1871	3.48	1.5	12	2.12	5	2.58	0.0	12	.69	12
1872	3.92	0.0	15	.94	5	4.47	0.0	16	1.07	2
1873	1.96	0.0	11	1.32	12	1.32	0.0	12	.56	4
1874	4.74	0.0	8	2.60	31	4.93	0.0	14	1.80	18
1875	3.31	0.0	11	1.15	25	4.85	0.0	8	2.20	19
1876	3.73	0.0	14	1.15	29	2.56	0.0	11	1.42	5
1877	1.94	0.0	13	1.05	3	1.98	0.0	9	.74	8
1878	2.14	0.0	10	1.25	23	5.42	0.0	10	2.50	24
1879	1.80	0.0	13	.58	14	4.73	0.0	15	1.75	4
1880	2.17	0.0	12	1.30	31	.73	0.0	8	.28	8
1881	4.85	0.0	15	2.75	17	3.38	0.0	11	.94	29
1882	4.52	0.0	12	2.65	29	4.44	0.0	13	1.85	6
1883	5.10	0.0	17	2.98	24	3.66	0.0	10	1.04	21
1884	5.42	0.0	15	1.23	29	1.37	0.0	6	.80	24
1885	3.38	8.	8	1.15	2	4.60	0.0	10	2.60	30
1886	4.67	0.0	10	1.45	8	2.74	0.0	9	1.35	27
1887	1.25	0.0	8	.64	30	3.36	0.0	11	1.22	24
1888	2.81	0.0	10	1.44	14	3.65	0.0	10	1.26	23
1889	1.86	0.0	10	.78	10	4.93	0.0	16	.88	2
1890	10.52	0.0	19	2.35	6	3.84	0.0	15	.97	14
1891	2.81	0.0	12	1.55	17	3.20	0.0	10	1.34	28
1892	1.94	0.0	11	1.13	23	5.96	0.0	17	2.70	29
1893	2.55	0.0	12	.67	17	2.69	0.0	12	.58	6
1894	3.84	0.0	7	1.40	19	2.90	0.0	8	.59	1
1895	2.13	0.0	5	.96	12	1.35	0.0	7	.45	27
1896	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1897	4.49	0.0	11	1.42	13	3.71	0.0	13	.94	4
1898	1.02	0.0	4	.61	30	5.28	0.0	10	2.10	.....
1899	4.12	0.0	9	1.27	20	4.10	0.0	13	1.17	14
1900	8.24	0.0	13	2.25	3	3.83	0.0	7	1.04	2
1901	2.07	Trace.	13	1.17	28	1.79	0.0	9	.50	23
1902	2.77	0.0	10	.74	26	6.03	0.0	16	1.25	26
1903	.73	0.0	3	.46	5	2.09	0.0	6	.77	13
1904	4.26	0.0	11	.96	11	2.17	0.0	8	.58	5

Year.	September.					October.				
	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.
1869	3.67	0	9	1.37	27	9.57	9	15	2.13	5
1870	2.23	0	6	1.12	4	5.53	1.5	12	1.82	20
1871	1.10	0	9	.38	27	7.50	0	12	4.43	12
1872	3.55	0	13	.92	24	6.01	0	13	1.25	2
1873	4.74	0	9	1.36	19	6.56	0	10	2.70	21
1874	4.37	0	10	2.90	20	1.14	0	7	.50	2
1875	5.10	0	10	1.95	17	4.75	0	15	1.31	31
1876	4.28	0	12	2.00	21	3.91	4	12	1.65	24
1877	1.11	0	5	.50	18	4.78	7	14	1.80	5
1878	2.00	0	9	.55	12	4.73	0	15	2.20	24
1879	4.93	0	10	2.25	8	3.49	0	10	2.30	29
1880	3.84	0	10	2.63	16	4.15	0	11	2.45	23
1881	2.35	0	9	1.00	11	3.57	0	14	1.98	18
1882	6.44	0	12	3.65	24	1.09	0	7	.53	18
1883	2.23	0	11	1.08	26	4.97	0	9	1.65	26
1884	2.19	0	13	.60	20	2.70	0	13	1.55	23
1885	2.52	0	5	1.56	23	5.12	0	12	1.56	3
1886	4.11	0	9	1.54	28	1.42	0	9	1.08	31
1887	.95	0	11	.54	25	3.00	0.25	9	1.15	21
1888	6.97	0	13	1.83	26	7.51	5	18	3.18	8
1889	2.21	0	5	1.28	19	4.04	0	11	1.89	30
1890	4.67	0	11	2.40	18	3.36	0	11	1.45	18
1891	3.68	0	8	2.37	7	2.85	0	11	1.70	8
1892	3.91	0	5	3.00	14	1.79	0	10	.65	27
1893	5.02	0	10	3.00	16	.....	.....	.....	.....	.....
1894	3.40	0	5	1.70	20	.....	.....	10	2.62	14
1895	1.05	0	3	.52	12	1.51	0.12	5	1.50	14
1896	8.00	0	9	4.34	6	3.75	0	15	.77	15
1897	2.65	0	7	.92	9	1.01	0	3	.88	12
1898	2.29	0	5	.94	5	6.19	0	7	1.71	5
1899	3.20	0	5	1.08	20	2.92	0	7	1.10	9
1900	2.94	0	7	1.22	21	5.70	T.	8	2.05	10
1901	4.22	0	8	1.39	11	4.12	T.	8	2.70	14
1902	1.94	0	8	.71	13	5.04	0	13	1.17	6
1903	1.21	0	4	.55	27	3.44	1.0	8	1.17	17
1904	6.47	0	13	2.37	14	3.10	T.	10	1.06	21

5. *Miscellaneous data.*—In Table 10 are given the dates of the opening and closing of navigation on the Penobscot River at Bangor each year from 1816 to 1905. Table 11 contains the dates of the severe frosts at Orono. Table 12 shows the number of thunderstorms each month from 1869 to 1904. Tables 13 and 14 give the solar and lunar halos, and in Table 15 are shown the number of auroras observed during each month. The following notes regarding various phenomena, while by no means complete, serve to indicate the character of the climate of Orono:

Ice.—The latest (?) date on which ice was formed each year from 1869 to 1875 was, 1869, April 11; 1870, April 8: 1871, March 13; 1872, April 20; 1873, April 20; 1874, April 16: 1875, April 16.

Snow.—Five inches of snow fell on May 3, 1885.

Gales.—Gales or high winds are recorded on the following dates: 1875, October 31; 1880, February 1, March 30, April 29; 1883, November 12; 1884, November 23; 1886, November 6, 18.

Destructive winds[2] are recorded on the following dates: 1870,

[2] The author states that he has underscored the violent windstorms that might be called tornadoes, but the words tornado and cyclone have specific definitions and violent wind does not necessarily imply the proper or improper use of these terms.—[Ed.]

TABLE 8.—*Precipitation* – Continued.

Year.	November.					December.				
	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.	Total, inches.	Total snowfall, in inches.	Days with .01 inch or more.	Maximum in 24 hours.	Date of maximum.
1869	3.36	.75	6	1.55	7	.....	.....	.....	.....	.....
1870	5.61	5.50	15	1.38	4	3.037	18.25	13	.70	13
1871	3.58	15.0	13	2.10	8	4.163	27.50	16	1.20	23
1872	7.06	10.0	14	2.40	6	3.615	31.50	18	.50	22
1873	5.05	24.0	10	1.44	8	1.735	14.0	12	.46	13
1874	3.06	10.0	9	.95	23	1.98	13.0	9	.60	14
1875	3.87	14.2	10	1.45	11	1.51	13.0	13	.43	17
1876	4.35	0.5	10	2.50	8	4.67	43.0	12	1.40	18
1877	7.95	3.0	12	2.60	27	2.15	6.0	7	1.40	6
1878	4.91	8.5	15	1.75	23	7.92	14.0	12	3.53	10
1879	2.98	10.0	12	1.62	29	3.60	19.5	17	1.10	7
1880	3.52	7.0	13	1.53	7	1.90	12.5	14	.65	16
1881	2.81	5.0	11	1.40	4	6.88	8.0	15	1.98	23
1882	1.78	5	6	.70	13	2.85	21.0	14	.62	6
1883	3.75	3	11	1.22	27	2.99	12.0	16	1.22	28
1884	3.99	7	13	1.28	6	4.74	16.0	11	2.20	22
1885	5.37	0.5	14	2.68	9	5.64	28.0	15	2.24	30
1886	8.67	6	16	4.58	7	6.38	38.5	12	1.74	24
1887	3.48	1	13	1.80	16	4.72	6.5	14	2.12	12
1888	5.73	10	12	1.84	10	4.96	19.6	11	2.40	18
1889	4.50	6	11	1.41	3	3.40	6.5	11	.78	19
1890	2.67	4.5	8	1.05	18	4.10	28.5	15	1.10	27
1891	2.88	2	8	1.36	27	4.76	10.5	9	1.78	30
1892	4.47	4	13	1.22	19	2.26	6.5	7	.96	8
1893	1.43	.....	4	.53	22	4.21	.....	10	.80	5
1894	1.24	0.5	4	.37	10	1.75	.....	4	.90	27
1895	3.61	.....	.....	1.25	8	.....	.....	.....	.....	.....
1896	4.23	5.5	11	1.41	5	1.30	.....	6	.58	8
1897	5.04	6	8	1.10	3	3.58	12.8	10	1.22	5
1898	6.84	6	8	2.50	10	1.07	7.0	4	.37	5
1899	2.01	7.5	6	.86	15	3.09	6.5	9	.75	4
1900	4.59	7.8	11	1.89	26	2.02	11.8	6	.80	5
1901	2.54	19.8	9	1.50	12	7.94	21.5	12	1.89	15
1902	1.76	3	7	.81	12	4.74	24.3	11	1.13	16
1903	2.79	15.5	9	.....	7	3.14	9.3	9	.96	13
1904	1.62	5.8	7	.83	14	2.00	19.2	7	1.10	28

TABLE 9.—*Days with 2.5 inches of precipitation.*

Year.	Day.	Amount.	Year.	Day.	Amount.	Year.	Day.	Amount.
		Inches.			*Inches.*			*Inches.*
1871	Oct. 12	4.43	1880	Sept. 16	2.63	1887	Apr. 30	3.26
1873	Oct. 21	2.70	1881	May 17	2.75	1887	July 25	4.38
1874	Feb. 4	2.85	1881	Aug. 8	2.95	1888	Oct. 8	3.18
1874	May 31	2.60	1882	Mar. 2	2.85	1889	Mar. 9	2.90
1874	Aug. 9	4.20	1882	May 29	2.65	1892	Aug. 12	2.80
1874	Sept. 20	2.90	1882	Sept. 24	3.63	1892	Sept. 14	3.00
1876	Feb. 15	4.45	1883	May 24	2.98	1893	Sept. 16	3.00
1876	Mar. 21	3.25	1883	July 14	2.95	*		
1876	July 24	2.50	1885	June 30	2.60	1896	Mar. 4	4.60
1876	Nov. 8	2.50	1885	Aug. 6	2.85	1896	Sept. 6	4.34
1877	Mar. 29	2.50	1885	Nov. 9	2.68	1898	Feb. 22	2.91
1877	Nov. 27	2.60	1886	Jan. 31	3.40	1898	Nov. 10	2.50
1878	June 24	2.50	1886	Feb. 28	2.60	1901	Oct. 14	2.70
1878	Dec. 10	3.53	1886	Nov. 7	4.58			
1879	Aug. 19	4.80	1887	Mar. 29	2.90			

*Complete precipitation records were not kept during this period.

TABLE 10.—*Opening, closing of navigation, Penobscot River, Bangor, Me.*

Year.	Open.	Closed.	Year.	Open.	Closed.	Year.	Open.	Closed.
1816	.....	Nov. 28	1846	Mar. 29	Dec. 15	1876	April 12	Dec. 10
1817	.....	Nov. 23	1847	April 23	Dec. 21	1877	Mar. 29	Dec. 30
1818	May 1	Dec. 10	1848	April 12	Dec. 21	1878	April 2	Dec. 19
1819	April 19	Dec. 5	1849	April 1	Dec 7	1879	April 24	Dec. 19
1820	April 18	Nov. 28	1850	April 12	Dec. 8	1880	April 6	Nov. 26
1821	April 15	Dec. 1	1851	April 8	Dec. 30	1881	Mar. 20	Dec. 11
1822	April 10	Dec. 5	1852	April 21	Dec. 15	1882	April 10	Dec. 9
1823	April 19	Dec. 9	1853	April 5	Dec. 8	1883	April 12	Dec. 16
1824	April 1	Dec. 12	1854	April 27	Dec. 5	1884	April 6	Dec. 19
1825	April 11	Dec. 14	1855	April 15	Dec. 1	1885	April 18	Dec. 17
1826	April 5	Dec. 16	1856	April 16	Dec. 1	1886	April 16	Dec. 5
1827	April 2	Dec. 6	1857	April 6	Dec. 10	1887	April 23	Dec. 22
1828	April 1	Dec. 18	1858	April 11	Dec. 12	1888	April 15	Dec. 13
1829	April 14	Dec. 16	1859	Mar. 30	Dec. 9	1889	Mar. 31	Dec. 14
1830	April 9	Dec. 8	1860	April 16	Dec. 7	1890	April 6	Dec. 6
1831	April 9	Dec. 3	1861	April 11	Dec. 20	1891	Mar. 26	Dec. 16
1832	April 19	Dec. 4	1862	April 18	Dec. 3	1892	April 2	Dec. 19
1833	April 9	Dec. 1	1863	April 19	Dec. 2	1893	April 14	Dec. 13
1854	April 8	Dec. 9	1864	April 8	Dec. 12	1894	Mar. 22	Dec. 23
1835	April 17	Nov. 27	1865	Mar. 31	Dec. 8	1895	April 5	Dec. 11
1836	April 12	Nov. 27	1866	April 1	Dec. 13	1896	April 12	Dec. 16
1837	April 15	Nov. 27	1867	April 18	Dec. 4	1897	April 7	Dec. 22
1838	April 21	Dec. 24	1868	April 18	Dec. 10	1898	Mar. 26	Dec. 14
1839	April 17	Dec. 1	1869	April 11	Dec. 9	1899	April 10	Dec. 27
1840	April 1	Dec. 1	1870	April 8	Dec. 21	1900	April 3	Dec. 12
1841	April 17	Dec. 19	1871	Mar. 13	Nov. 17	1901	April 2	Dec. 20
1842	Mar. 21	Nov. 19	1872	April 19	Dec. 10	1902	Mar. 21	Dec. 8
1843	April 21	Nov. 30	1873	April 19	Dec. 2	1903	Mar. 12	Dec. 18
1844	April 12	Nov. 27	1874	April 16	Dec. 11	1904	April 3	Dec. 6
1845	April 21	Dec. 7	1875	April 16	Nov. 29	1905	Mar. 31	.....

TABLE 11.—*Dates of some severe frosts at Orono, Me.*

Year.	Date.	Year.	Date.	Year.	Date.
1869	Oct. 6	1881	June 6, 7	1892	Sept. 8
1870	Sept. 12	1881	Sept. 21	1893	Sept. 11
1871	Sept. 11	1882	Sept. 13	1894	Sept. 3
1872	Oct. 5	1883	Aug. 29	1895	.....
1873	Aug. 28	1884	Sept. 13	1896	Sept. 5
1874	Oct. 4	1885	Sept. 12	1897	Sept. 27
1875	Sept. 11	1886	Sept. 14	1898	.....
1876	June 8	1887	Sept. 11	1899	.....
1876	Aug. 22	1888	Sept. 6	1900	.....
1877	Sept. 7	1889	Oct. 3	1901	.....
1878	Sept. 23	1890	July 19	1902	.....
1879	June 9	1890	Sept. 22	1903	Sept. 30
1879	Sept. 26	1891	Oct. 9	1904	Sept. 22
1880	Sept. 24				

TABLE 12.—*Thunderstorms at Orono, Me.*

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1869	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....
1870	.....	.....	.....	2	.....	2	1	2	.....	.....	.....	.....
1871	.....	.....	.....	1	1	2	3	.....	1	.....	.....	.....
1872	.....	.....	.....	.....	.....	2	2	2	3	.....	.....	.....
1873	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....
1874	.....	.....	1	.....	1	2	2	.....	.....	.....	.....	.....
1875	.....	.....	.....	.....	2	1	2	.....	1	.....	.....	.....
1876	.....	.....	.....	.....	1	.....	1	1	.....	.....	.....	.....
1877	.....	.....	.....	.....	1	.....	2	4	1	.....	.....	.....
1878	.....	.....	.....	.....	3	2	5	1	1	.....	.....	.....
1879	.....	.....	.....	.....	4	2	3	1	.....	.....	.....	.....
1880	.....	.....	.....	.....	4	.....	5	1	1	.....	.....	.....
1881	.....	.....	.....	.....	1	2	3	4	1	.....	.....	.....
1882	.....	.....	.....	.....	2	3	6	2	2	.....	1	.....
1883	.....	.....	.....	.....	1	2	2	2	.....	1	.....	.....
1884	.....	.....	.....	.....	2	3	3	1	1	1	.....	.....
1885	.....	.....	.....	2	2	2	3	1	.....	3	.....	.....
1886	.....	.....	.....	.....	2	3	3	1	2	.....	2	.....
1887	.....	.....	.....	.....	1	2	5	3	2	.....	.....	.....
1888	.....	.....	.....	.....	1	3	2	3	.....	.....	.....	.....
1889	.....	.....	.....	.....	1	4	4	3	.....	1	.....	.....
1890	.....	.....	.....	.....	.....	2	2	2	1	1	.....	.....
1891	.....	.....	.....	.....	2	3	1	4	2	.....	.....	.....
1892	.....	.....	.....	.....	.....	2	.....	5	.....	.....	.....	.....
1893	.....	.....	.....	.....	.....	2	1	.....	1	.....	.....	.....
1894	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....
1895	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1896	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....
1897	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....
1898	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
1899	.....	.....	.....	.....	.....	.....	9	.....	.....	.....	.....	.....
1900	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....
1901	1	.....	1	.....	.....	.....	2	1	.....	.....	.....	.....
1902	.....	.....	.....	3	2	.....	2	3	.....	.....	.....	.....
1903	.....	.....	.....	.....	.....	.....	.....	.....	2	2	.....	.....
1904	.....	.....	.....	1	3	3	2	.....	5	.....	.....	.....

TABLE 13.—*Solar halos at Orono, Me.*

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1869	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1870	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1871	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1872	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1873	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1874	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
1875	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1876	.....	.....	.....	1	.....	1	.....	.....	1	.....	.....	.....
1877	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
1878	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....
1879	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
1880	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....
1881	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1882	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1883	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1884	.....	.....	1	.....	1	.....	.....	.....	.....	1	.....	.....
1885	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
1886	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1
1887	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
1888	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....
1889	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1890	.....	1	.....	3	1	.....	.....	1	.....	.....	.....	.....
1891	.....	3	.....	.....	2	.....	.....	.....	.....	.....	.....	.....
1892	.....	.....	.....	2	2	.....	.....	.....	.....	.....	.....	.....
1893	.....	.....	1	2	.....	.....	.....	.....	.....	.....	2	.....
1894	.....	1	.....	2	.....	.....	.....	.....	.....	.....	.....	.....
Sum	1	6	4	14	8	2	1	2	1	1	2	1

July 14; 1873, July 26; 1882, August 15; 1890, July 8; 1892, June 14.

Parhelia are noted as follows: 1887, January 31; 1889, Feb-

ruary 22; 1890, January 18, February 10, March 25, 31, April 29; 1891, February 2, 3, 5, 27, May 21, 22; 1892, February 7.

Meteors were seen: 1875, March 24; 1887, September 15; 1888, January 4, December 28; 1889, November 17; 1890, August 11, 12; 1891, January 8.

The zodiacal light was observed in the evening on the following dates: 1877, March 21; 1878, January 29, 30; 1879, January 10, 14, 23; 1880, January 11; 1882, March 7, 8; 1883, January 29, February 7, 8, 26, March 8; 1886, February 22, 23; 1887, February 14, 21; 1888, February 2, 3, 29, December 23; 1889, December 16; 1890, January 17, 18, 21, 29, February 9, 10, 11, 13, 15, 16, March 9; 1891, January 8, 10, February 2, 10, 27, March 6, 7. Observations were made practically every evening, but of course certain of the phenomena may have been missed.

TABLE 14.—*Lunar halos at Orono, Me.*

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1869	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....
1870	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
1871	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1872	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....
1873	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1874	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....
1875	.....	.....	.....	.....	1	.....	.....	.....	1	.....	.....	.....
1876	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....
1877	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
1878	.....	.....	2	.....	.....	.....	.....	.....	.....	1	.....	.....
1879	.....	1	.....	.....	.....	.....	.....	.....	1	1	.....	.....
1880	.....	.....	2	1	.....	.....	.....	1	.....	.....	.....	.....
1881	.....	2	2	1	.....	.....	.....	.....	.....	1	.....	.....
1882	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
1883	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
1884	.....	2	.....	.....	1	.....	.....	.....	1	2	.....	.....
1885	.....	.....	1	2	.....	.....	.....	.....	.....	.....	.....	1
1886	.....	1	.....	1	.....	1	.....	.....	.....	.....	1	1
1887	.....	1	1	1	.....	.....	.....	.....	.....	1	1	2
1888	.....	.....	1	1	.....	.....	.....	.....	.....	1	.....	1
1889	.....	1	.....	.....	.....	1	.....	.....	.....	.....	.....	3
1890	.....	4	1	2	.....	.....	.....	1	.....	2	.....	.....
1891	.....	.....	1	.....	1	1	2	.....	.....	1	1	1
1892	.....	2	2	2	.....	1	.....	.....	.....	.....	.....	1
1893	.....	1	7	.....	3	.....	.....	.....	1	.....	.....	.....
1894	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....
1895	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sum.....	15	22	17	14	5	4	0	2	4	10	3	10

TABLE 15.—*Auroras at Orono, Me.*

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1869	.....	.....	4	5	2	.....	.....	.....	3	4	1	.....
1870	3	3	4	1	1	1	.....	1	2	1	2	2
1871	.....	5	3	2	2	2	2	1	5	2	8	2
1872	1	2	2	.....	2	.....	1	4	.....	3	3	2
1873	2	.....	1	3	1	3	2	.....	1	2	.....	.....
1874	2	1	.....	2	.....	.....	1	.....	2	5	.....	1
1875	.....	1	.....	2	.....	.....	.....	.....	1	.....	.....	.....
1876	.....	.....	.....	1	.....	.....	.....	.....	1	.....	.....	.....
1877	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
1878	.....	1	.....	.....	.....	.....	.....	.....	1	.....	.....	2
1879	.....	.....	.....	1	.....	.....	.....	.....	1	1	.....	.....
1880	.....	.....	3	2	.....	.....	.....	4	.....	1	3	.....
1881	1	.....	.....	2	.....	.....	.....	.....	1	.....	.....	1
1882	.....	2	2	1	.....	.....	.....	1	.....	4	3	3
1883	.....	5	3	1	.....	.....	1	.....	1	1	.....	.....
1884	.....	.....	3	4	.....	.....	.....	.....	.....	1	1	.....
1885	.....	.....	.....	.....	1	.....	.....	3	1	1	1	3
1886	.....	.....	2	2	.....	1	.....	2	3	3	1	.....
1887	.....	2	.....	1	3	.....	.....	2	1	1	2	.....
1888	1	1	1	.....	3	1	.....	1	1	3	.....	1
1889	.....	.....	.....	1	.....	1	1	.....	.....	1	4	2
1890	3	2	.....	.....	.....	.....	3	2	3	2	5	.....
1891	1	1	3	1	3	1	.....	.....	4	2	3	1
1892	1	8	6	6	1	.....	4	1	3	5	1	3
1893	.....	.....	.....	1	.....	.....	.....	.....	2	.....	5	.....
1894	.....	5	2	.....	5	2	3	1	.....	.....	.....	.....
1895	.....	.....	.....	3	1	.....	.....	.....	.....	2	.....	.....
1896	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....
1897	.....	1	5	3	.....	.....	.....	.....	.....	.....	.....	.....
1898	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
1899	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1901	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1902	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
Sum.....	16	40	45	46	22	12	18	23	37	48	44	23

Earthquakes occurred: 1870, October 20; 1871, October 19; 1872, January 9; 1881, June 21.

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C. F. TALMAN, Acting Librarian.

The following titles have been selected from among the books recently received, as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies. Most of them can be loaned for a limited time to officials and employees who make application for them.

Austria-Hungary. Hydrographisches Amt der Kaiserlichen und Königlichen Kriegsmarine in Pola.
Jahrbuch der meteorologischen, erdmagnetischen und seismischen Beobachtungen. Neue Folge. IX. Band. xxxiii, 190 pp. f°. Pola. 1905.

Austria-Hungary. Kaiserliche Königliche Central-Anstalt für Meteorologie und Erdmagnetismus.
Jahrbücher der K. K. Central-Anstalt für Meteorologie und Erdmagnetismus. Jahrgang 1903. Neue Folge. XL. Band. v. p. f°. Wien. 1905.
Same. Anhang. 89 pp. f°. Wien. 1905.

Baden. Centralbureau für Meteorologie und Hydrographie.
Jahres-Bericht des Zentralbureaus für Meteorologie und Hydrographie im Grossherzogtum Baden mit den Ergebnissen der meteorologischen Beobachtungen und der Wasserstandsaufzeichnungen am Rhein und an seinen grösseren Nebenflüssen für das Jahr 1904. 97 pp. 6 plates. f°. Karlsruhe. 1905.

Carnegie Institution of Washington.
Desert Botanical Laboratory of the Carnegie Institution. By Frederick Vernon Coville and Daniel Trembly MacDougal. 58 pp. 8°. Washington. 1903.
Report of Committee on Southern and Solar Observatories. 170 pp. 8°. Washington. 1903.

Eiffel, G.
Études pratiques de météorologie et observations comparées des stations de Beaulieu, Sèvres et Vacquey pour l'année 1903. xxx, 377 pp. f°. Paris. 1905.
Same. Atlas des planches. 24 plates.
Les observations courantes en météorologie et comparaison des stations de Beaulieu, Sèvres et Vacquey. Conférence faite a la Société Astronomique de France le 4 janvier 1905. (Extrait du Bulletin de la Société Astronomique de France.) 43 pp. 8°. Paris. 1905.

Gesellschaft für Erdkunde zu Berlin.
Bibliotheca geographica. Herausgegeben von der Gesellschaft für Erdkunde zu Berlin. Bearbeitet von Otto Baschin. Band X. Jahrgang 1901. xvi, 571 pp. 8°. Berlin. 1904.

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Report of the Isthmian Canal Commission, 1899-1901. 688 pp. 86 plates. 4°. Washington. 1904.

Kassner, [Carl Julius Hermann].
Die normale Verteilung der Niederschläge in Deutschland und die Dürre im Jahre 1904. (Deutsche Landwirtschafts Gesellschaft. Sonderabdruck aus "Jahrbuch" 1905.) Pp. 89-105. 8°.

Mill, Hugh Robert.
British rainfall, 1904. Forty-fourth annual volume 87, [279] pp. 8°. London. 1905.

Naturforschender Verein in Brünn.
Verhandlungen. XLII. Band. 1903. 253 pp. 8°. Brünn. 1904.
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C. F. TALMAN, Acting Librarian.

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NOTES AND EXTRACTS.

THE PIONEER FORECASTERS OF HURRICANES.

WASHINGTON, D. C., *August 24, 1905.*

THE EDITOR,
THE WASHINGTON POST,
Washington, D. C.

DEAR SIR:

In answer to your editorial of this morning, in reference to a pamphlet published by Father Drum, permit me to say that there is no disagreement between the observers of Bélen College and the Weather Bureau, as is evidenced by the following communication:

GEORGETOWN UNIVERSITY,
WASHINGTON, D. C., *August 24, 1905.*

MR. WILLIS L. MOORE,
Washington.

DEAR PROFESSOR MOORE:

From the Washington Post of August 24, I observe that the brochure "The Pioneer Forecasters of Hurricanes" has given occasion to the conviction that there exists some friction between the Bélen College Observatory and the U. S. Weather Bureau, of Washington.

For four years I have been engaged in the Bélen Observatory and I can attest that the famous Father Viñes, as well as the present director, Father Gangoiti, have always appreciated and highly esteemed the labors of the Washington Weather Bureau, and that their relations with the same have at all times been most amicable.

It is well known that your officials and yourself, not on one occasion only, but repeatedly, have honorably and favorably referred to the forecasts and labors of the Belen Observatory, and I am confident that what has been written concerning the change brought about by the introduction of the U. S. Weather Bureau into all the Antilles did not emanate from headquarters, and could not in the least refer to the island of Cuba or its meteorologists.

In behalf of my confréres of Bélen I wish to make this very sincere acknowledgment of the merits of the U. S. Weather Bureau, and of its undoubted services to the advance of science and to the profit, not only of the inhabitants of the States, but also of all neighboring countries.

I conclude,

Very truly yours,

(Signed) S. SARASOLA, S. J.

I am sure that Father Drum would not knowingly do an injustice to the Weather Bureau, which issued ample warnings to all shipping from one to two days in advance of the Galveston hurricane. A careful reading of his pamphlet will show that he was comparing the forecasts of Bélen College with the statements of some one of our local observers. He did not intend to criticise the Bureau as a whole; but the local observer had no authority to issue warnings for Gulf ports, and was not the official spokesman of the Bureau.

WILLIS L. MOORE,
Chief U. S. Weather Bureau.

SIMULTANEOUS WEATHER ANOMALIES IN ICELAND AND EUROPE.

In the Meteorologische Zeitscrift for February, 1905, Dr. Julius Hann publishes under the title "Anomalies of the weather in Iceland, 1851–1900, and their relations to the simultaneous weather anomalies in northwest Europe," a short extract from a paper by him in the Sitzungsberichte der Wiener Akad., vol. 113, January, 1904. An English translation of the former by Dr. R. H. Scott appears in the Quarterly Journal of the Royal Meteorological Society, April, 1905, vol 31, No. 134, page 152. The following account has been compiled by consulting all three of these. The data here given are in English measures.

Doctor Hann discusses his subject in two phases, viz: (A) The simultaneous anomalies of temperature, pressure, and rainfall during the winter months at Stykkisholm, Greenwich, Brussels, and Vienna. (B) Relations between the oscilations of pressure at Stykkisholm and Ponta Delgada, Azores, or between the two certers of action of the atmosphere over the North Atlantic Ocean.

So far as Iceland is concerned the inquiry is based on the means of pressure and temperature for Stykkisholm, 1846–1900, for which station a long series of records, embracing all elements, was carried out by one man, Olaf Thorlacius, who observed from November, 1845, to the end of 1891, and has left the record for this long period without any gap. For Europe Hann used the records for Greenwich, Brussels, and Vienna for the period 1851–1900, and for the Azores the records for 1865–1890 at Ponta Delgada.

The great permanent subtropical area of high pressure about the Azores and the deep barometric minimum around Iceland, at the centers of which are situated Ponta Delgada and Stykkisholm, respectively, are designated "centers of action of the atmosphere" by Teisserenc de Bort.

Doctor Hann's study of the relations between these centers and the weather of western Europe tends to show that the weather anomalies of western Europe are closely and causally related to the occasional extensions of the Icelandic area of low pressure.

(*A*) In the discussion of the simultaneous anomalies at Stykkisholm and at Greenwich, Brussels, and Vienna, which is restricted to the winter months, as the phenomena are more marked at that season, Doctor Hann finds the following results:

(1) The probability of a simultaneous opposition in the pressure departure at Stykkisholm and that in northwest and

central Europe amounts to 80 per cent in January, and 74 per cent in February, a mean of 70 per cent for the winter months.

(2) In a slight majority of cases the temperature departure from the mean at Stykkisholm is opposite to that in northwest Europe. No great weight is attached to this relation as the temperature anomaly is so often due to local causes.

(3) On comparing the pressure departures at Stykkisholm with the simultaneous temperature departures in northwest and central Europe it is found that a deepening of the pressure minimum over Iceland produces a rise in the winter temperatures of northwest and central Europe, and vica versa, a rise in the temperature over Iceland produces a fall in the winter temperatures over northwestern Europe.

(4) In the case of precipitation, simultaneous departures from the normal in opposite senses are found to occur at Stykkisholm and Brussels in 60 per cent of the cases. A much more decisive result than in the case of temperature. See (2) above.

(5) A comparison of the greater simultaneous pressure and temperature departures in all months was made by tabulating by months all the large pressure departures at Stykkisholm (.20 inch and over for October to April, inclusive, .136 inch and over in May and September, and .118 inch and over in June, July, and August), and then setting down beside these the mean of the simultaneous temperature departures at Brussels and Greenwich. The mean values of these corresponding variations for each month and the year are shown in Table 1:

TABLE 1.—*Large pressure departures at Stykkisholm and corresponding temperature departures at Greenwich and Brussels.*

Month.	Positive departures.				Negative departures.			
	Number of cases.	Pressure departure at Stykkisholm.	Mean of temperature departures at Brussels and Greenwich.	Signs not agreeing with means.	Number of cases.	Pressure departure at Stykkisholm.	Mean of temperature departures at Brussels and Greenwich.	Signs not agreeing with means.
		Inches.	°			*Inches.*	°	
January	11	+.406	−3.2	2	14	−.311	+2.5	2
February	12	+.374	−4.1	1	12	−.347	+2.5	2
March	10	+.307	−1.1	3	11	−.303	+3.1	0
April	10	+.224	−1.3	3	8	−.264	+0.7	2
May	7	+.165	−0.4	4	7	−.224	+2.5	1
June	9	+.177	−0.4	4	11	−.169	+0.7	3
July	9	+.142	−1.3	2	7	−.165	+0.4	3
August	10	+.189	−0.5	3	7	−.181	+2.0	0
September	10	+.221	−1.3	3	10	−.193	+1.3	3
October	10	+.291	−1.8	2	8	−.291	+0.9	1
November	14	+.335	−2.5	2	12	−.303	+2.5	1
December	10	+.350	−3.1	3	15	−.264	+2.7	1
Year	122	+.272	−1.8	32	122	−.260	+2.0	19

TABLE 2.—*Semiannual means of the larger pressure variations at Stykkisholm and the simultaneous temperature variations at Greenwich and Brussels.*

Half year.	Positive pressure departures.				Negative pressure departures.			
	Number of cases.	Mean pressure departure.	Mean temperature departure.	Probability.	Number of cases.	Mean pressure departure.	Mean temperature departure.	Probability.
		Inch.	° *F.*			*Inch.*	° *F.*	
Winter	67	+.347	−2.7	0.81	72	−.303	+2.4	0.90
Summer	55	+.150	−0.9	0.65	50	−.208	+1.2	0.76

It will be seen that a rising barometer in Iceland is accompanied by lower temperatures over northwest Europe in 74 per cent of the cases and that with a fall of the barometer in Iceland there is a simultaneous rise of temperature at the selected stations in 84 per cent of the cases. This table affords one of the most direct proofs that has been given as yet of the influence of the permanent barometric depression over Iceland in moderating the climate of northwest Europe. When the intensity of the Icelandic low is weakened it is at once shown by the lowering of the temperature in northwestern and even in central Europe.

That the influence of the great barometric departures in Iceland on the temperature of northwest Europe is greater in winter is shown by Table 2.

(6) It is natural to turn the question around and ask what were the pressure deviations at Stykkisholm at the time of the greatest positive and negative monthly and annual anomalies of temperature at Greenwich (1851 and 1900 for instance). In 42 cases of great positive temperature anomaly at Greenwich during 50 years it was found that a corresponding negative pressure anomaly existed at Stykkisholm in 83 per cent of the cases. Out of 41 cases of great negative departure 85 per cent coincided with a simultaneous positive anomaly at Stykkisholm. The mean values are shown in Table 3.

TABLE 3.—*Simultaneous variations of monthly mean pressure and temperature at Greenwich and Stykkisholm.*

Temperature departures at Greenwich.	Pressure departures at Stykkisholm.
° *F.*	*Inch.*
+4.9	−.117
−5.0	+.185

(7) A similar comparison of the annual means shows a similar relation though the contrast is less strong, evidently this is due to the influence of the summer temperatures which are less dependent on the Icelandic minimum.

(8) A comparison of the rainfall at Brussels and Stykkisholm for the 22 years 1857–1878, shows opposite departures from the normal at the two places 90 per cent of the time, while for the 22 years 1879–1900, the departures were in the same sense 55 per cent of the time. This shows how easily short periods of records may lead to error.

In the second part of his paper Doctor Hann deals with the relations between oscillations of pressure at Stykkisholm and Ponta Delgada, or between the two centers of action of the atmosphere of the North Atlantic Ocean.

To determine if these two centers of action are in any sort of relation of dependence, at least in regard to the intensity of their development, the departures of the monthly means of pressure at Ponta Delgada (1865–1890) were compared with the simultaneous departures at Stykkisholm. Next, all the large departures of barometer level at Ponta Delgada of .118 inch and above were compared with the corresponding simultaneous pressure departures at Stykkisholm and the means of the whole derived. From these comparisons it is found that the departures at the two places have opposite signs in 77 per cent of the cases.

The greatest negative departures of the pressure at Ponta Delgada are attended by positive departures at Stykkisholm in 83 per cent of the cases. With great positive departures at Ponta Delgada negative departures are found to coexist at Stykkisholm in 71 per cent of the instances examined.

In a similar manner the correspondence of the variations of pressure at Ponta Delgada with the great positive and negative departures at Stykkisholm were examined. The results are even more decisive, for negative departures at Ponta Delgada are found to correspond to the greatest positive departures at Stykkisholm in 80 per cent of the cases. Eighty-seven per cent of the greatest negative departures of pressure at Stykkisholm have corresponding positive departures at Ponta Delgada. It will be seen, therefore, that departures in the opposite sense occur in 83 per cent of the cases.

It may therefore be asserted that the two centers of action of the atmosphere in the North Atlantic, the high pressure area near the Azores, and the low pressure area over Iceland are interdependent.

It is to be remarked in this connection that when the absolute pressure at the Azores is higher than the average, and at the same time the absolute pressure at Iceland is below the mean as happens in more than 70 per cent of the cases, then in consequence of the gradient over the North Atlantic being greater than the normal the atmospheric machine works more actively and the warm oceanic winds from the west sweep over western and central Europe. Conversely, when the pressure at the Azores is reduced, and the pressure at Iceland increased at the same time as is generally the case, then the pressure gradient from south to north is weakened or even reversed, and the moderating influence of the Icelandic low on the climate of northwest Europe diminishes or even disappears.

It is to be observed that there may be large positive or negative departures of temperature in central Europe without the pressure at Stykkisholm being either high or low: e. g., the radiation winter 1879–1880, when clear, cold weather prevailed, had low pressure in Iceland, but the pressure was also low at Ponta Delgada.

The cases in which the pressure at the Azores is increased while that in Iceland is reduced are theoretically the most interesting. On the contrary, if the pressure at the Azores is lower and that in Iceland is higher this may be due and often is so, as in the winter of 1880–81 to a displacement of the anticyclone to the north, and at such times no theoretical reasoning can be based on the apparent gradient from the Azores to Iceland. However, when the pressure at the Azores is unusually high this can not well be considered as a simple displacement of the subtropical anticyclone, but only as a greater intensity of it owing to increased activity of the atmospheric circulation.

When the northeast trade blows much stronger than usual this will tend to increase the barometric maximum on its right hand. This will increase the atmospheric whirl over the North Atlantic Ocean and thereby the pressure minimum at its center near Iceland will be deepened.

The increased pressure at the Azores and the deepening of the minimum over Iceland which is connected therewith may thus be related to each other as cause and effect. This consideration imparts more theoretical interest to the circumstance above demonstrated, that decided positive pressure departures at the Azores occur together with negative ones in Iceland. That the probability of this relation only reaches 70 to 80 per cent may be attributed to the fact that the reasoning is based on the pressure conditions at two fixed points in consequence of which lateral displacements of the central areas of high or low pressure may easily produce apparent exceptions.

It is only isobaric maps of the Atlantic Ocean that can give the true key to all cases. In order to study these for 50 years it will be necessary to have 600 monthly maps; it will be fully 20 years before the "Hoffmeyer Charts" have reached that age and even then it will be found that the most convenient and shortest expression for the gradient over the North Atlantic Ocean will be afforded by the difference of pressure between the two stations of Ponta Delgada and Stykkisholm.—*E. R. Miller.*

THE SUGAR BEET AND ITS CLIMATIC ENVIRONMENT.

The Bureau of Chemistry has just published Bulletin No. 95 "The Influence of Environment upon the Composition of the Sugar Beet". This is in continuation of previous Bulletins Nos. 64, 74, 78, on the same subject, and represents the results of the fourth year of the study. Eleven stations including that at Washington, D. C., have been considered, viz: The Agricultural Experiment Stations of Colorado, Fort Collins; Iowa, Ames; Indiana, Lafayette; Kentucky, Lexington; New York, Geneva and Ithaca; Oregon, Union; Wisconsin, Madison; Wyoming, Laramie.

At all these stations a uniform variety of beet was furnished from the Bureau of Chemistry with fairly uniform directions as to sowing and cultivation. Samples of the soils were sent to the Bureau for analysis, and complete meteorological data were tabulated. About a month prior to the usual time of harvest in the respective localities a sample harvest of 25 beets was gathered and forwarded to the Bureau of Chemistry. This sampling was repeated weekly until the frost prevented further operations, or the beets began to deteriorate. In some cases irrigation was practiced, alongside of other experimental plats which had no irrigation.

At the Washington station, on the Potomac flats, the soil on which the beets were grown had been made artificially by dredging the channel of the Potomac River.

At the end of the Bulletin Doctor Wiley summarizes the conclusions from which we take the following notes as to the influence of the climate:

> In general it will be seen that the content of sugar in the beet varies with latitude, the lowest sugar content in the lowest latitude and vice versa. While, as is to be expected, there are variations in this curve, the general statement that the content of sugar rises as the latitude increases is again established. There is a less definite relation between the hours of sunshine and the sugar content of the beet. Inasmuch as it is generally conceded that the formation of sugar in the plant is a function which is largely influenced by light and can not be conducted without it, it seems only reasonable to suppose that the greater the quantity of light the greater the quantity of sugar developed. It is evident, therefore, that as the latitude increases the number of hours of light increases, thus giving the plant laboratory a longer working day. It has also been pointed out that light is more important than clear sunshine, since those radiations of the sun which are most active in stimulating the cellular activity of plants seem to suffer no marked diminution of power in passing through strata of aqueous vapor. The number of clear days varies greatly at different stations; the lowest number was at Ithaca: Washington, Lexington, Lafayette, and Ames all had a very large number of clear days in proportion to the number of days in the month.
>
> * * * There is an intimate relation between the percentage of sugar in the beet and the length of the day. * * * The purity of the beets bears a very close relation to the quantity of sugar. * * * The temperature of the air varies inversely as the sugar content of the beet being highest when the sugar is lowest and lowest where the sugar is highest. * * * There is a general agreement between the percentage of sugar in the beet and the altitude of the station, but this agreement is not uniform, and it is evident that the only effect of the altitude will be found in diminishing the temperature, and that otherwise it can not have any possible effect upon the composition of the beet. There is an apparent relation between the amount of rainfall and the sugar content, the curves rising together, but this may be regarded as an indication of no value, but rather as accidental, and, moreover, there are wide and violent variations from the general agreement. The distribution of rainfall appears to have had no direct effect upon the content of sugar in the beet. It is evident, however, that there might be such a distribution of rainfall as to influence unfavorably the sugar content, and this has been pointed out in the discussion of the data of the various stations. There would be undoubtedly a tendency of the rainfall to diminish the sugar content if it should be so distributed as to restrain the normal growth of the beet during the growing period, especially in August, or to unduly stimulate it by excessive rainfall during the period when ripening would naturally take place, as in September and October. A number of instances of this kind have already been pointed out.

As Professor Wiley seems to have satisfactorily demonstrated by four years of special study in this country (confirming many years of experience in Europe) that the beet, like the cabbage and probably other plants, increases the sweetness of its juice in proportion as it is grown in more northern latitudes, it is natural at first thought to attribute this to the coldness of the climate or to the increase in length of the day and consequently in the total amount of sunshine during the growing period. But if we analyze the matter carefully, we shall see that it is probably not the temperature of the air as such or the length of the day as such that is important. So long as the temperature is above freezing and the surrounding air is moist the action of the sunlight and of the diffuse sky light

stimulates the chemical changes that are going on within the leaf. Even the faint twilight or the blue light that simmers down through a leafy forest, or the fractional part of daylight received by an object in the shade, is sufficient to maintain these chemical changes; strong daylight is usually not essential, and the final result depends more on the duration of the gentle twilight than on its intensity. In fact, such changes may go on under artificial light that is far less intense than the ordinary daylight. The amount of light received by a horizontal surface in the open air when the sun is 20° above the horizon, as during the arctic summer, is almost equally divided between the direct light of sunshine and the diffuse light of the sky; the amount received by a leaf of a plant will depend upon its aspect, and it may easily receive more from the sky than from the sun. We must, therefore, believe that as the storage of sugar within the beet root must depend originally upon its manufacture in the leaf, and as the quantity diminishes with temperature, the manufacture and the storage both depend essentially on the *duration* of the chemical action of skylight and sunlight upon the juices of the leaf; this must be the reason why the beet is sweeter in proportion as it is grown in northern latitudes. From this point of view we see why it is that nothing but excessively thick clouds and rain cut off enough sunshine to materially affect the sweetness of the beet, since those waves of light that are most active in stimulating the formation of sugar pass quite freely through ordinary moist air and thin clouds.

The temperature of the air is often confounded with the temperature of the soil. This latter temperature depends so much on the loss of heat from the surface of the earth by radiation through a clear sky that we are apt to forget that the soil may be very cold all day long at a few inches depth, while the surface of the ground is warmed up by a few hours of direct sunshine. Clear blue sky does not warm up the soil although it does exert a stimulating influence on the leaves of plants. If warmth is injurious to the sugar content of the beet as these investigations seem to show, then it becomes important to ascertain by experiments in mulching whether it is the warmth of the soil or the warmth of the leaf that is objectionable. In the mountainous parts of France it is a common experience that irrigation with very cold water from the glaciers retards greatly the growth of wheat and other grains, while it favors the growth of some grasses, many of which grow at temperatures near freezing. By analogy we might infer that the temperature of the irrigation water used in beet fields would be a matter of importance. At any rate the investigation of the beet root and its environment requires that we should study very carefully the temperature of the soil down to the lowest end of the tap root.

WEATHER BUREAU WORK DURING THE ECLIPSE OF AUGUST 30, 1905.

The U. S. Naval Observatory having organized an expedition for astronomical work during the eclipse of August 30, the U. S. Weather Bureau was invited to carry out the meteorological work. The details of the necessary organization were entrusted to Prof. Frank H. Bigelow who, with his assistant, Mr. Stanislav Hanzlik, left Washington about June 14 and 18, respectively, and with others, sailed from Norfolk in the U. S. transport *Cæsar*. The astronomers of the party left New York on the U. S. S. *Minneapolis;* supplies and instruments were sent on the U. S. S. *Dixie.*

Under date of July 28, near Tortosa, Spain, Professor Bigelow writes as follows:

The *Dixie* arrived at Gibraltar July 6, the *Cæsar* July 7, and the *Minneapolis* July 17. I was then transferred to the *Minneapolis* by Admiral Chester. We all sailed from Gibraltar July 19, the *Dixie* with Mr. Hanzlik and his equipment direct to Bona, where he is to establish our three African stations. He now understands my plans fully and I believe he will do the work properly. It had been my intention to go there from Valencia as soon as my Spanish stations were in order, but the *Minneapolis* sails July 28, on its course, Valencia, Bona, Lisbon, Cadiz, Gibraltar, returning to Valencia by August 17, so that I can not go that way, and I know of no other transportation from Valencia to Bona. I shall have to leave Mr. Hanzlik to do his duty as well as he can by himself. Captain Norris, in charge, will assist him with the organization.

The *Cæsar* and *Minneapolis* arrived at Valencia July 21. Several days, Friday to Monday, were consumed in making trips of exploration to settle upon the sites of the astronomical stations and finally Daroca is chosen for the central station and Porta Coeli for that near the southern edge of the track.

The boxes went ashore Monday afternoon, July 24, and while the transfer and preliminary work was being done by the astronomers, I located my instruments for two secondary stations. One I have placed at Castellon in the Institute. The other I have established in the Solar Physics Observatory of the Ebro, about two miles distant from Tortosa, where I am writing this note.

Admiral Chester has given me enough men for the primary stations and I am arranging with the people here for the secondary stations. At Castellon I paid a small sum for the work and set up our own instruments. They took meteorological observations there 20 years ago, but had abandoned them. At Tortosa they have a splendidly equipped observatory on the very plan that we are developing at Mount Weather and they will give me a copy of their observations for 40 days for $10. This plan is cheaper for the Government than the other one of sending and maintaining our naval officers and men.

To-day (July 28) I return to Valencia, thence to Porta Coeli to organize the work there, then to Daroca to put that station in order, then to Zaragoza where I have already secured my observer, then to Guadalajara or Madrid, and finally I will return to Daroca for my own share in the eclipse.

The meteorographs were fully revised or repaired at Gibraltar and the *Cæsar* will call there to take on the kites which I have urgently requested to be sent.[1]

On the return homeward the *Cæsar* will sail from Valencia, September 5, for Nice, and thence September 13, and should arrive in Hampton Roads about October 5.

It will not be possible for me to attend the meeting of the International Meteorological Committee at Innsbruck, Austria, which will not get under way until September 11. However, I shall have from September 2 to September 13 to myself and propose to go to Paris, Potsdam, Brunswick, and Munich on my way to Nice.

At this Observatory of the Ebro they are organized as it should be. It is under the order of the Jesuit Fathers, and they have about ten highly educated, well trained men, each one responsible for a line of work, and all under one scientific director, Cirera. It is the only possible policy for success, this is inexpensive for them and the priests get no salaries; they are supported by wealthy Catholics.

Tortosa is in the eclipse track and it will carry off the honors in solar physics this time.

Under date of August 10, Professor Bigelow writes from Madrid, as follows:

The primary astronomical station near the southern edge of the shadow is located at Porta Coeli, about seven miles from Betera to the north, this being twelve miles west of Valencia. It is placed in the grounds of the old convent, not in use at present, except in an irregular way by visitors during the summer. The site is admirable and the climate all that could be desired. The work is in charge of Professor Littell, assisted by Peters, Anderson, and Hill, with numerous helpers. At the time of the eclipse the party will be increased to about forty persons by details from the U. S. S. *Minneapolis*, which is at present cruising to Bona, Algiers, Tangier, Lisbon, and Gibraltar, returning to Valencia about August 17.

My observatories have been running steadily since about August 3. The trio of stations, Porta Coeli, Castellon, and Tortosa, is strongly affected by the sea breeze and as the total eclipse occurs in the midst of the local convection it will be interesting to try to separate the effect of the shadow proper from it. The other three stations, Daroca, Zaragoza, Guadalajara, are too far inland to feel this wind from the sea and the contrast between the curves for the two sets of stations ought to be instructive.

At Daroca, near the central line, the astronomical station is being established with Professor Eichelberger in charge and Mitchell, Yowell, and Hoxton with several others in cooperation. I have placed more of my instruments at Daroca than at Porta Coeli, intending to return

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[1] Five new kites, with extra fixtures and materials for repairs, etc., and with improved attachments for kite meteorographs were sent Professor Bigelow, August 10, 1905, by express, in care of the American Consul at Gibraltar, and it is hoped these will reach him in time to be used on the return trip across the Atlantic.—*C. F. M.*

thither from Madrid for my own observations with the Ebert electrometer, the Brashear polarimeter, and the mercury actinometer.

At Zaragoza I placed the work in charge of Prof. José Blanco, S. J., at the Colegio del Salvador, in an excellent location.

At Guadalajara I was fortunate enough to secure the assistance of Lieut. Col. Vivez y Vich, the Director of the Military Aerostatic Service of Spain, who already has a meteorological station there. He showed me his large balloons intended for the eclipse ascensions at Burgos, for the International Commission, also his homing pigeons, and the various valuable works he is conducting.

At Madrid I called upon the director of the observatory, who gives the time signals to all astronomers for longitude, etc., and left with him my last package of circulars on the shadow bands.

I return to Daroca to-morrow and shall remain there until September 1, when we return to Valencia. The ships all meet at Nice on September 5 or 6 and sail for home September 13. I have heard nothing from Doctor Hanzlik about the African stations.

METEOROLOGY IN PETERMANN'S GEOGRAPHISCHE MITTEILUNGEN.

Since the eminent climatologist, Prof. Dr. A. Supan, became the editor of Petermann's Mitteilungen that important geographical journal has devoted an increased attention to meteorology. Not only have occasional special articles of importance appeared therein, but we have in mind particularly the reviews of meteorological publications and the invaluable indexes to local climatological data as arranged by countries and stations. These reviews and indexes constitute the "Geographischer Literaturbericht," or systematic review of geographical literature, which occupies quite as large a space as the mitteilungen themselves. Thus, in the fiftieth volume, for 1904, we have 298 pages of the latter and 226 pages of the reviews and indexes, besides 21 large charts. In these climatological indexes special attention is paid to records of observed rainfall. Number 14 is a number that is retained throughout volume No. 50 for what are called local climatological contributions in which references to numerical data are arranged by countries and stations, and this is followed by other reviews bearing on pressure, moisture, glaciation, change of climate, and terrestrial magnetism. The separate reviews are numbered, the last number being 799.

In the current volume for 1905 the opening article by Nansen on the "Causes that produce ocean currents" is a clear and popular presentation of the various theories that have been advanced on this matter, but we see no mention of Professor Ferrel's explanation of the Gulf Stream, although Nansen's presentation of the subject is closely analogous to that of Ferrel in his Recent Advances, Chapter VII, and elsewhere.

The local climatological contributions constitute No. 34 of these reviews for 1905 and occupy six closely printed pages, followed by a series of perhaps ten pages of reviews of recent publications on the rainfall, and especially on the circulation of the atmosphere. There is a very appreciative notice of the work of Dr. O. L. Fassig on kite-flying in the Tropics by Dr. R. Süring of the Meteorological Office in Berlin. There are also elaborate reviews of the various publications that have appeared in the MONTHLY WEATHER REVIEW from Professors Bigelow, Dewar, Shaw, Algué, and others.

In the Mitteilungen for March 28, 1905, we find a note by Supan on the kite work over the ocean, especially that by Hergesell over the Atlantic Ocean for the Prince of Monaco. With regard to the ascension made on August 9, 1904, west of the Canary Islands, and therefore far removed from all continental influences, he says:

> We may assume the conditions there found as typical for the whole region between Portugal, the Canaries, and the Azores, except in the immediate vicinity of the latter. As the kite ascended the thermograph record shows that the temperature fell adiabatically up to about 500 meters, then rose rapidly up to about 1100 meters, where it was warmer than at the earth's surface, and whence it steadily fell up to 5000 meters. The warm and dry intermediate layer, the gradual shifting of the wind from northeast to northwest by west, and the complete failure of the southwest trade winds at the altitude where it always prevails on Teneriffe led the Prince of Monaco to consider this as a very local phenomenon.

On the other hand Supan considers that:

> These kite observations were not made in the region of well developed trade winds, but within the subtropical zone of high pressure. The distribution of temperature and moisture seems to suggest that the movement of the air diminishes with altitude, even in the Bahamas. Mr. Fassig's work was done outside of the region of the maximum trades and he found no inversion of temperature, but a steady adiabatic diminution. We shall not be able to draw any theoretical conclusions until we have a section through the atmosphere over the whole North Atlantic.

On pages 81–90, and 108–115, Dr. Jacob Hoffman gives an exhaustive review of our knowledge of the temperatures on the highlands of tropical Africa, south of the equator. As the records from every available station and traveler are quoted we can not summarize this paper which goes into the details of the influence of insolation, nocturnal radiation, the wind, the cloudiness, and the presence of oceans and lakes. The reader will be amazed to perceive how much has been recorded relative to African meteorology.

On page 91 we have a list of the courses of lectures on geography in German universities during the summer of 1905. As meteorology and climatology are generally included under geography, we give the following items relating thereto:

METEOROLOGY IN GERMAN UNIVERSITIES AND TECHNICAL SCHOOLS.

Aix-la-Chapelle.—Technical High School. Doctor Polis; two hours weekly on climatology.

Berlin.—The University. Doctor Philippi; one hour weekly on the climate of geological epochs. Prof. Dr. von Bezold; two hours weekly on theoretical meteorology or thermodynamics of the atmosphere. Technical High School.—Doctor Kassner; one hour weekly on precipitation with special reference to technology.

Bonn.—The University. No meteorology.

Brunswick.—Technical High School. Professor Koppe; two hours weekly on barometric hypsometry.

Breslau.—The University. No meteorology.

Dantzic.—Technical High School. No meteorology.

Darmstadt.—Technical High School. No meteorology.

Dresden.—Technical High School. No meteorology.

Erlangen.—The University. No meteorology.

Freiberg in Baden.—The University. No meteorology.

Giessen.—University. No meteorology.

Göttingen.—University. Professor Wagner; general climatology, four hours weekly. Professor Wiechert; meteorology, two hours weekly.

Greifswald.—University. Professor Credner; elements of climatology. Professor Holtz; one hour weekly in meteorology, including its optical phenomena treated popularly with experiments. Professor Deecke; on glaciers and the glacial epoch.

Halle in Saxony.—The University.—No meteorology.

Hanover.—Technical High School.—No meteorology.

Heidelberg.—The University. Professor Wolf; two hours weekly on meteorology.

Jena.—The University. No meteorology.

Carlsruhe.—Technical High School. No meteorology.

Kiel.—The University. No meteorology.

Königsberg in Prussia.—The University. No meteorology.

Leipsic.—The University. No meteorology.

Marburg in Hesse.—The University. No meteorology.

Munich.—The University. No meteorology. Technical High School. No meteorology.

Münster in Wurtemburg.—University. No meteorology.

Rostock.—University. No meteorology.

Strassburg in Alsace.—University. Professor Hergesell; selected chapters in modern meteorology treated by the seminary method, two hours weekly.

Stuttgart.—Technical High School. No meteorology.

Tübingen.—The University. No meteorology.

Würzberg.—University. No meteorology.

AUSTRIA.

Czernowitz.—The University. No meteorology.

Gratz.—The University. Professor Bendof; meteorology, three hours a week. Technical High School. No meteorology.

Innsbruck.—University. Professor Trabert; weather and climate, three hours weekly; the föhn, one hour weekly.

Prague.—German University. Professor Spittaler. Practical meteorology, viz, instruments, observations, and computations, three hours weekly. German Technical High School. No meteorology.

Vienna.—The University. Professor Hann; introduction to the computation and reduction of meteorological and climatological observations two hours weekly. Professor Pernter; meteorology, viz, three hours a week on the theory of instruments and practise in observing and computations at the Central Institute for Meteorology. Doctor Valentin; on barometric hypsometry, one hour a week. Technical High School. No meteorology.

SWITZERLAND.

Basle.—No meteorology.

Berne.—University. No meteorology.

Zurich.—University. Professor Stoll; the atmosphere and the hydrosphere. Polytechnicum. No meteorology.

Out of 44 universities and technical schools using the German language 13 recognize meteorology as worthy of special mention.

In the Mitteilungen for May, 1905, page 118, Doctor von Lendenfeld, of Prague, gives the result of a study of the hot winds in Melbourne.

The hot winds of Melbourne.—These hot winds come from the north and occur throughout the summer of the Southern Hemisphere. They may last from a few hours to three days, increasing steadily in warmth and velocity until they reach 40° to 44°C. and 60 or 80 kilometers per hour. They end with the sudden formation of thunderstorms, and the wind swings around to the south and the temperature may fall to 22°C., in the first hour. They occur on the front of a region of low pressure which moves from west to east, and their severity increases in proportion as the center of low pressure approaches the city of Melbourne. The sudden shift of wind and fall of temperature occurs at the moment when the center of the pressure passes the meridian of Melbourne. This hot wind comes from the interior of Australia; it passes over the southwest portion of the Australian Alps, lying north of Melbourne at an altitude of about 700 meters, and descends along the southern slope of these hills. By this descent the wind becomes compressed and heated so that it has something of the characteristics of the föhn wind as to heat and temperature. By drying up the sands and soil over which the wind blows it allows the particles that would otherwise be stuck together by moisture to separate from each other so that a great mass of dust is carried by the wind. The heavens are darkened and the sun is invisible. The leaves of the trees dry up and drop off on account of its warmth and the unusual quantity of bacteria causes flesh, milk, and other foods to spoil rapidly.

[However, this is not a föhn wind properly so called as the latter derives its extra heat from the latent heat set free by condensation of vapor, whereas the hot winds of Melbourne derive their extra heat from the hot, dry soil of the interior of Australia.—ED.]

SHOWERS OF FISH.

Although for a century past numerous miscellaneous questions that are common among those who have not considered the subject carefully have been banished from meteorological treatises yet we find them cropping up everywhere in the classes of children devoted to nature study. In answer to an occasional correspondent it may be well to state in these columns that it is well established as highly probable that in some cases violent winds have swept up from shallow ponds and wet swamps not only the water and the leaves but also the smaller animals such as little fishes, tadpoles and frogs. In fact, in an early number of the MONTHLY WEATHER REVIEW will be found on record a case in which a small turtle was carried up and was coated with ice before it fell as the center of a hailstone. Heavy objects invariably come down soon and within a few miles, but such expressions as "a rain of toads", "a rain of fish" are exaggerations. The yellow pollen of the pine is often carried up in great quantity and descending forms a so-called "shower of sulphur". Sometimes the spores of fungi are brought down by the rain and grow so rapidly after the rain is over that the ground is covered with a reddish slime, sometimes called a "shower of blood". At other times great quantities of the spawn of frogs descending with the rain and gathering into the pools of water make a "shower of tadpoles". But the so-called "shower of frogs" and the "shower of angle worms" are not likely to be cases of this kind. The latter are often drowned out of their abodes in the soil and seek fresh air at the surface. We do not know that these showers of frogs and worms have been very carefully investigated by any naturalist, and the subject is not very important, but in general the study of such questions belong to natural history, not to meteorology.

HAWAIIAN CLIMATOLOGY.

For many years it has been the policy of the Weather Bureau to publish in the MONTHLY WEATHER REVIEW climatological data from different parts of the globe that were not likely to become otherwise accessible to the student of meteorology. Those interested in the climatology of Hawaii will notice that the tabular data from that territory is now restricted to the table of data for Honolulu. This is because the general monthly report of the Climate and Crop Section of Hawaii gives very full details and is printed in a sufficiently large edition to allow of furnishing copies to all who are especially interested in the subject. These may be had by direct application to the Section Director, U. S. Weather Bureau office, Honolulu, T. H.

SCIENTIFIC AERONAUTICS.

We have published some account of the action taken at the fourth conference of the International Committee for Scientific Ballooning which took place on the 9th of August, 1904, at St. Petersburg.

An official copy of the resolutions then adopted was forwarded to the United States Government through the Russian Ambassador on April 27, 1905, drawing attention to the necessity of an international organization for aerial sounding and asking whether the Government of the United States will contribute toward the printing of the publications.

The resolutions state that the sum expended for publication during the first three years was 30,000 francs or about $6000, and that the same amount will probably be needed in the future. Up to the present time the expense has been defrayed by one of the countries, viz, Germany, but it is recommended that each country be invited to defray a share of the expense, receiving in return a corresponding number of copies of the publication. Private individuals are also free to contribute or subscribe.

The committee believes that the organization of stations for flying kites for meteorological purposes will be very important either in connection with or independent of aerial soundings and will fill up the wide gaps between the balloon stations. The committee decided to have ascensions made for three successive days in April and also at the end of August, 1905, and to make the times of ascent accord with the hours of observations for the morning weather charts. The committee recommends it as of the highest importance that steam vessels, both governmental and private, should be supplied with apparatus for doing kite work at sea, and that the officials of these vessels should be instructed in the necessary handling of the instruments.

The committee considers it of importance that the international observations of clouds be made strictly according to the definitions of the international classification and by experienced observers. It is especially necessary that aerial soundings should be accompanied by simultaneous observations of clouds.

The president of the committee is requested to select the best situations for mountain stations and to obtain as complete observations as are possible. The observations on mountains will be printed in connection with the records of the sounding balloons and kites.

The work of aerial exploration by means of sounding balloons and kites as well as permanent mountain stations is one that may well excite enthusiasm and emulation among the wealthy patrons of science in America. It is not necessary to leave all this work to the Carnegie Institution for Research, or to the overburdened universities, or to the regular routine of Weather Bureau methods. There is abundant room here for independent individual originality and local enterprise. The Great Plains of the Mississippi watershed offer unparalleled advantages for the highest balloon work and kite work. The Rocky Mountains on the west and the Appalachians on the east offer a host of peaks from 6000 to 15,000 feet high, some of them already crowned with hotels and dwellings where self-registering apparatus can easily be kept in operation. Similarly the numerous owners of private yachts can contribute immensely to our study of the atmosphere over the ocean, if, like Teisserenc de Bort, they will but devote their vessels, when not otherwise in use, to meteorological work on the high seas. What is especially needed is kite work and balloon work in the region of the Saragossa Sea and in sections to and fro across the equator from tropic to tropic on the Atlantic, Pacific, and Indian oceans.

We shall never know much about the atmosphere so long as we neglect these opportunities. Nor shall we ever understand the mechanics of storms and the general circulation of the atmosphere until we have enough observations throughout its whole extent to check our various hypotheses and enable us to concentrate on the one true theory.

MIRAGE AFTER SUNSET.

Under date of September 19, 1904, Mr. Charles N. Brown, of South Orange, N. J., communicates the following account of a phenomenon that was seen by himself and many others:

Our party of eleven were in camp on Staten Island, N. Y., at the edge of the bluff 400 feet east of the pavilion at Barbour's Grove (the Clark estate) on the south shore of Princess Bay, north from Keyport a mile and a half. At 8 o'clock p. m. on August 16, 1904, our attention was attracted by strange lights 400 yards out from shore. The water was still, the moon (two hours from setting) shone on our backs and the air was still with no cloud in the sky. The lights were stationary and we at once recognized the Luna Park, Dreamland, and tower lights (which we could see every night). On their left were the lights of Midland Beach, on their right was depicted a long narrow strip of seashore many miles long, very distinct on the water, with several bright lights on the extreme right. In front of Coney Island a boat moved with a light in it, apparently a rowboat with a man in it rowing. All this was seen right side up, and you can imagine how keenly we enjoyed it all and longed to reproduce it with a camera. After ten minutes during which time we went down to the beach (fourteen feet to sea-level), the vision passed suddenly away. At that moment the mirage cloud, which was before invisible, was seen. Then we saw in the usual place the real lights of Coney Island. This cloud was entirely horizontal, very narrow, black, and stationary. It began to change very shortly and some of us watched it for an hour and a half still suspended over the horizon, during which time it almost entirely disappeared and reappeared seven or eight times.

A QUADRUPLE RAINBOW.

Ciel et Terre publishes the following account of a quadruple rainbow observed at Mons, Belgium, August 31, 1904, by M. A. Bracke:

A shower had just ceased (17 h. 55 m. to 18 h. 30 m.) when a superb rainbow appeared—a complete semicircle, very broad, with magnificent colors, presenting distinctly the seven hues of the spectrum. A little above, less distinct and less broad, was the segment of an arc showing the red, the yellow, and the green. Below, and very near the large arc, was a third, having a breadth about equal to a quarter of the last, and showing but two colors—mauve-red and green. Finally, beneath this same arc was distinctly visible, but at intervals only, a fourth, colored like the one above it. The phenomenon lasted a quarter of an hour.

METEOR IN MONTANA.

The Inter-Lake of Kalispell, Mont., under date of July 14, 1905, contains the following item regarding a brilliant meteor seen there on July 8:

A brilliant meteor passed over this section last Saturday night, 12:35 seventy-fifth meridian time, Sunday, July 9, 1905, and apparently was visible over northern Montana, Idaho, and Washington. Reports from widely separated localities give practically the same account. The meteor lighted up the country like day for an instant and was so near the earth that the rush through the air was plainly heard.

REORGANIZATION OF METEOROLOGY IN AUSTRALIA.

The following paragraph from an editorial in the Daily Telegraph, Sydney, N. S. W., April 11, 1905, shows that a process of reorganization of scientific work is going on that will, we hope, be of advantage to meteorology and climatology. Now that the federal government is step by step consolidating Australian policies, we may expect that meteorology will be differentiated from astronomy and other cognate subjects, and will be allowed to stand by itself. A general meteorological office and a daily weather map of the whole continent would be a most important contribution to meteorology.

OBSERVATORY CONTROL.

Arrangements will probably shortly be made by the federal authorities to take over the astronomical and meteorological work of the various states and bring them under one controlling head with subdepartments in the states. Owing to this fact, the New South Wales minister for education does not propose to take any steps in the direction of filling the position of government astronomer and meteorologist, now made vacant through the retirement of Mr. Russell. During the past twelve months Mr. H. A. Lenehan has been acting government astronomer and Mr. H. A. Hunt acting meteorologist. The minister states that these gentlemen will continue to occupy these positions, pending the changes to be made by the federal government in taking over the observatory department.

BACK NUMBERS.

The Editor occasionally receives requests from libraries for volumes or numbers of the MONTHLY WEATHER REVIEW for the earlier years, 1873–1893, in order to complete sets that are accessible to the public and are frequently used. Those who have such early numbers to dispose of will confer a favor by notifying the Editor.—*C. A.*

THE STATION AT PORT AU PRINCE, HAITI.

Mr. R. E. Pollock, Assistant Observer, Weather Bureau, reports under date of July 16, 1905, that he has established a Weather Bureau station at the observatory of the Institution Saint Louis de Gonzague, Port au Prince, Haiti, and has

given the necessary instructions to the Professor of Physical and Natural Sciences, Frère Constantin, who will have charge of the work.

Mr. Pollock reports that the wind vane and anemometer support has been placed on the brick roof of the observatory of the college and that the exposure is an excellent one. The foundation for the support is of solid mahogany blocks buried in cement to a depth of about ten inches and is so firm that it is expected to withstand the strongest wind. In the observatory are many modern well-kept instruments.

A SEVERE HAILSTORM AT GRAND RAPIDS, MICH.

Mr. C. F. Schneider, Section Director, Grand Rapids, Michigan, reports as follows in regard to the hailstorm of Thursday, May 4, 1905:

Severe thunderstorm. First thunder heard at 1:20 p. m., central standard time; last at 6:45 p. m. Storm came from the southwest. Excessive rain from 1:40 to 2:20 p. m., accompanied from 1:46 to 1:56 p. m. by the most violent and copious fall of hail ever known to have occurred in this vicinity. The hail fell without cessation for fully ten minutes, almost completely covering the ground. The stones were particularly large, most of them being from one to two inches in diameter and some slightly larger than two inches. The storm passed over the central portion of the city, there being but little rain and no hail in the extreme western and eastern sections. Considerable damage was done by the hail, the greenhouses being especial sufferers. Nearly all skylights and many windows in residences and churches within the storm's path were broken. Precipitation to the amount of 0.79 inch fell between 1:40 and 2 p. m., most of it falling between 1:50 and 2 p. m.

The above has been held for some time hoping to obtain data that will enable us to define the length and width of the area covered by hail, but as the only other detailed reports at hand also come from Grand Rapids, we may infer that the hailstorm did not cover any very large area in the central portion of lower Michigan. The following are additional stations in lower Michigan reporting hail on the fourth of May: Grand Haven, light hail between 5:10 and 6:05 p. m.; Hagar, hail and thunder, between 5:30 and 6:15 p. m.; Reed City, hail and thunder, between 1:30 and 2:45 p. m.; Stanton, hailstorm, between 12:30 and 3:00 p. m., did very little damage; Webberville, hard electric storm with hail, between 4:20 and 6:50 p. m.

Heavy thunderstorms were reported from nearly all sections of lower Michigan on the above date, but the falls of hail were apparently confined to small and widely scattered areas.

METEOROLOGICAL COURSE AT WILLIAMS COLLEGE.

In the MONTHLY WEATHER REVIEW for November, 1904, page 517, the course in meteorology at present maintained at Williams College was briefly described. As there stated a lithographed syllabus, covering both text-book and lectures, is closely followed. Chapters VI to VIII, inclusive, of this syllabus were published in the MONTHLY WEATHER REVIEW for April, 1905, page 159, after being somewhat revised by the author, and Chapters I to V are now published so that teachers and lecturers may have the advantage of examining the whole work. The numbers on the right-hand side refer to the sections of Davis's Elementary Meteorology, which is the chief book of reference used by Professor Milham, and which is followed quite generally as a text-book.

A COURSE OF INSTRUCTION IN METEOROLOGY AT WILLIAMS COLLEGE.

Chapter I. Introduction—the atmosphere.
II. Heat of the atmosphere.
III. The observation and distribution of atmospheric temperature.
IV. The pressure and circulation of the atmosphere.
A. The observation and distribution of pressure.
B. The observation and distribution of the winds.
C. The convectional theory and its comparison with the observed facts.
D. A general classification of the winds.
V. The moisture of the atmosphere.
A. The water vapor of the atmosphere.
B. Dew, frost, fog.
C. Clouds.
D. Precipitation.
VI. The secondary circulation of the atmosphere.
A. Tropical cyclones.
B. Extratropical cyclones.
C. Thundershowers.
D. Tornadoes.
E. Waterspouts, whirlwinds.
F. Cyclonic and local winds.
VII. Weather bureaus and their work.
VIII. Weather prediction.
IX. Climate.
X. Floods and river stages.
XI. Atmospheric electricity.
XII. Atmospheric optics.
XIII. Atmospheric acoustics.

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CHAPTERS VI-VIII.

[See page 139, Monthly Weather Review, April, 1905.]

Practical laboratory work in observing, computing, charting, and forecasting, as well as special studies, are expected of the students. At the close of the course, if time permits, a few lectures are given on climates, floods, river stages, atmospheric electricity, optical and acoustical phenomena of the atmosphere.

CONTRIBUTIONS INVITED.

It has occurred to the Editor that possibly among Weather Bureau officials, cooperative observers, and other readers of the MONTHLY WEATHER REVIEW there are some who would occasionally like to send in an article for publication, but refrain because they have not been invited. The majority of the articles that appear in the REVIEW have been voluntary contributions and are of an unofficial character. The Chief of Bureau does not order them written and the Editor is allowed the liberty of publishing whatever will be for the benefit of meteorology. He hopes, therefore, that no one having an interest in the progress of this science will refrain from writing because he has not been invited. None of the articles that appear are to be considered as embodying principles or instructions obligatory upon the service unless, indeed, it is expressly so stated by order of the Chief. Inasmuch, therefore, as each author has the liberty of expressing his own opinion, there is no reason why there should not be a free expression of views on any topic that comes up for discussion. Of course it will sometimes happen that an article may be submitted that can not be published immediately or that may need considerable modification before appearing in print. In such cases the criticisms and advice of the Editor and his assistants will always be at the service of our correspondents.

A CAUTION AS TO HYPOTHESES.

An editor does not always feel free to decline articles offered for publication by distinguished investigators, in fact he usually welcomes new ideas as being the best stimuli to other minds. But he should call the attention of younger students to the danger of piling one hypothesis upon another, building up a work of the imagination that is beautiful to contemplate, but not necessarily in complete harmony with nature. It is much easier for man to describe how the Creator might have done, than to get at the facts of the universe that surrounds us and of which we form a part.

Hypotheses are the essential steps to every investigation. We always try many before we find something that harmonizes through and through with observations and may be temporarily accepted as an apparent law of nature. The investigator often publishes a full statement of his successive trials of hypotheses and their failures as an explanation of the long time required to get at the truth. Other students in the same line of work profit by reading such statements and learn not to be carried away by the enthusiasm inspired by a first apparent happy thought. Some of the most distinguished men in science have been conspicuous for the tenacity with which they adhered to hypotheses that have ultimately been abandoned. Thus, in the struggle to wrest from nature her greatest of all secrets, the structure of a molecule, the theory of Boscovich has had an almost pernicious influence, but may begin to yield good results when we are able to modify it by adding the dynamic considerations that have developed during the past few years. In astronomy the cycles of the ancients reigned supreme for 2000 years until Copernicus, Kepler, and Newton permanently dislodged them. Newton, himself, says "I will not touch hypotheses," and yet he was perpetually discussing them and rejecting them one by one. His theory of universal gravitation was indeed an hypothesis until he was able to demonstrate its validity by utilizing Kepler's rules which were based on observations. In his "Treatise on Optics" he introduced an hypothesis relative to the nature of light whose defense enlisted all the energies of his followers, until the battle was given up two centuries later in favor of the so-called "undulatory theory of light" and even this latter now stands in need of modification.

The mathematician deals with matters of pure hypothesis and logic, but the physicist deals with a material world that he must measure and weigh.

Many illustrations might be cited to show the inadvisability of building up a complex structure of mixed hypotheses and well established facts or laws that is apt to become undermined and eventually to tumble down. The wisest way is to admit only one hypothesis at a time and not build upon it very much until its validity has been established beyond all peradventure. Our contemporary, Nature, has adopted from Wordsworth a line that should serve as a motto for all true lovers of meteorology:

> "To the solid ground
> Of nature trusts the mind which builds for aye."

Not but that we shall make many mistakes in endeavoring to follow nature. We may often deceive ourselves and sometimes be inclined to say that nature deceives us. We often wish to push ahead to the very end of the whole matter, when nature says "Stop right here, the world is not yet ready for the answer to this question."

CORRIGENDA ET ADDENDA.

Page 292, fig. 64, insert the following legend: "Retardation of rotation in different zones of the sun." Page 293, fig. 68, insert the following legend: "The upper section shows the variation in relative number of sun spots in an 11-year period, and the lower section shows the corresponding changes in the

form of the solar corona in passing from minimum to maximum, and back to minimum." Page 294, fig. 70, insert the following legend: "Relative frequency of the occurrence of hydrogen flames as seen on the edge of the northern hemisphere of the sun in a spectroscope; the distribution on the southern hemisphere is similar to that shown on the northern." Page 294, fig. 71, insert the following legend: "Comparison of the annual changes of the prominences on the sun and the temperatures and pressures on the earth during the years 1872–1900."

THE WEATHER OF THE MONTH.

By Mr. WM. B. STOCKMAN, Chief, Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure is graphically shown on Chart VIII and the average values and departures from normal are shown in Tables I and V.

The normal type of mean pressure obtained during the month; the highest, with values slightly greater than 30.00 inches, obtaining over the South Atlantic and east Gulf States; and the lowest, with values of 29.75 inches, obtaining over the western portion of the southern Plateau region.

The mean pressure for the month was above the normal in New England generally, on the coast of North Carolina, in the upper Mississippi Valley, North Dakota, the slope regions, middle Plateau region, eastern-southern Plateau region, and on the Washington coast; elsewhere it was below the normal. As a rule the departures were small, the greatest positive and negative departures amounting to but .06 inch.

The pressure for the month diminished from that of June, 1905, in the Lake region, upper Mississippi Valley generally, in western Oregon, and northwestern California; elsewhere the mean pressure showed an increase over the preceding month. Over the slope and Plateau regions the increase was somewhat marked, the maximum increase amounting to +.15 inch over portions of the northern and middle slope regions. The greatest decrease was over the northern portion of the upper Lake region, and amounted to —.05 inch.

TEMPERATURE OF THE AIR.

The mean temperature for the month was generally below the normal in the region between the Alleghany and Rocky Mountains, and above normal in the remaining districts. The greatest positive departures ranged from +2.0° to +3.8° and occurred over west-central Idaho, Oregon, and eastern and central Washington. The negative depertures were more pronounced than the positive, as a rule, and covered a much greater area, ranging from —2.0° to —4.2° over most of the region of negative departure.

The average temperatures for the several geographic districts and the departures from the normal values are shown in the following table:

Average temperatures and departures from normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	8	68.5	+ 0.6	— 9.9	—1.4
Middle Atlantic	12	74.8	+ 0.5	— 6.6	—0.9
South Atlantic	10	79.5	+ 0.3	— 4.6	—0.7
Florida Peninsula*	8	81.6	+ 0.2	+ 2.7	+0.4
East Gulf	9	79.8	— 1.0	— 8.4	—1.2
West Gulf	7	79.7	— 2.2	— 9.6	—1.4
Ohio Valley and Tennessee	11	75.7	— 0.7	— 9.6	—1.4
Lower Lake	8	71.5	+ 0.3	—11.2	—1.6
Upper Lake	10	66.4	— 1.3	— 8.7	—1.2
North Dakota*	8	65.9	— 2.4	— 0.7	—0.1
Upper Mississippi Valley	11	72.5	— 2.6	—10.4	—1.5
Missouri Valley	11	71.7	— 3.4	— 9.2	—1.3
Northern Slope	7	67.9	— 1.5	— 3.7	—0.5
Middle Slope	6	73.5	— 2.8	— 9.9	—1.4
Southern Slope*	6	77.3	— 1.8	—14.3	—2.0
Southern Plateau*	13	76.7	— 2.1	— 5.0	—0.7
Middle Plateau*	8	70.2	— 0.8	+ 3.6	+0.5
Northern Plateau*	12	70.7	+ 2.7	+ 9.9	+1.4
North Pacific	7	62.2	+ 0.9	+ 9.8	+1.4
Middle Pacific	5	68.0	+ 0.8	+ 7.5	+1.1
South Pacific	4	70.4	— 0.3	+ 7.3	+1.0

* Regular Weather Bureau and selected cooperative stations.

By geographical districts the temperature was above the normal in the Atlantic districts, lower Lake region, northern Plateau and north and middle Pacific regions.

Maximum temperatures of 90°, or higher, occurred generally throughout the country, except in portions of the Rocky and Alleghany Mountain regions; of 100 or higher in portions of the following States and Territories: New Jersey, South Carolina, Georgia, Texas, Oklahoma, Indian Territory, Kansas, Colorado, Nebraska, Iowa, South Dakota, New Mexico, Arizona, Nevada, California, Oregon, Washington, and Idaho; of 110°, or higher, in southwestern Arizona, central California, and south-central Washington; and of 120° to 128° in southwestern Arizona and extreme southeastern California.

Freezing temperatures were reported from many Rocky Mountain stations.

In Canada.—Prof. R. F. Stupart says:

> The temperature was from 1° to 2° below average in Assiniboia, also in Manitoba, except in the northern portion; average over the Lake Superior district and in the extreme southwestern counties of Ontario, and everywhere else above the average. Interior stations in British Columbia recorded the largest positive departures amounting to 4°. Quebec and the Maritime Provinces gave a positive departure of about 2°, and the larger part of Ontario from 1° to 2°.

PRECIPITATION.

The distribution of total monthly precipitation is shown on Chart III.

The precipitation was below normal in the Pacific and Plateau regions, and portions of the slope regions, central Missouri, Ohio, and upper Mississippi valleys, the east Gulf States, southern New England, east-central New York and New Jersey, and Florida generally; and above normal in the remaining districts. The greatest deficiency did not equal 3.0 inches, while the excess in east-central Maryland, District of Columbia, and the western portions of Virginia and North Carolina ranged from 4.0 to 7.2 inches; 4.0 to 9.6 inches in northwestern Louisiana, western Arkansas, and southwestern Missouri, and 8.0 inches in western South Dakota.

Average precipitation and departure from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	8	3.12	86	—0.5	—4.4
Middle Atlantic	12	5.77	138	+1.6	—1.6
South Atlantic	10	6.53	110	+0.6	—2.4
Florida Peninsula*	8	8.10	125	+1.6	+1.5
East Gulf	9	4.78	86	—0.8	—0.1
West Gulf	7	5.28	171	+2.2	+6.3
Ohio Valley and Tennessee	11	3.49	85	—0.6	—3.4
Lower Lake	8	3.18	103	+0.1	—1.2
Upper Lake	10	3.94	130	+0.9	+0.8
North Dakota*	8	4.12	151	+1.4	+1.1
Upper Mississippi Valley	11	3.00	79	—0.8	—2.4
Missouri Valley	11	4.87	129	+1.1	+1.4
Northern Slope	7	2.99	177	+1.3	+3.1
Middle Slope	6	4.26	144	+1.3	+4.8
Southern Slope*	6	4.30	130	+1.0	+6.8
Southern Plateau*	13	0.97	71	—0.4	+5.7
Middle Plateau*	8	0.52	84	—0.1	+1.0
Northern Plateau*	12	0.44	69	—0.2	—1.1
North Pacific	7	0.23	25	—0.7	—7.7
Middle Pacific	5	T.	100	0.0	—2.6
South Pacific	4	0.05	100	0.0	+3.1

* Regular Weather Bureau and selected cooperative stations.

By geographical districts the precipitation was normal in the middle and south Pacific districts; above normal in the Middle and South Atlantic States, Florida Peninsula, west Gulf States, Lake region, North Dakota, Missouri Valley, and slope regions, and below normal in New England, east Gulf States, Ohio Valley and Tennessee, upper Mississippi Valley, Plateau regions, and north Pacific district.

In Canada.—Professor Stupart says:

The precipitation was much in excess of the average amount in nearly all parts of Ontario, except along the shores of Lake Erie. It was also well above the average in eastern Manitoba, and also in a portion of southwestern Quebec; elsewhere over the large remaining area in the Dominion, the average rainfall was not maintained, if we except a few isolated localities, noticeably Swift Current, with a positive departure of 1.4 inches, and Edmonton and Qu'Appelle, with three-tenths and two-tenths, respectively.

CLEAR SKY AND CLOUDINESS.

The mean monthly cloudiness was normal in North Dakota; below normal in the Gulf States, southern slope region, northern and southern Plateau regions, and northern and middle Pacific coasts; and above normal in New England, Middle and South Atlantic States, Florida Peninsula, Ohio Valley and Tennessee, Lake region, upper Mississippi Valley, Missouri Valley, northern and middle slope, middle Plateau region, and south Pacific coast.

The averages for the various districts, with departures from the normal, are shown in the following table:

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.3	+ 0.4	Missouri Valley	5.0	+ 0.6
Middle Atlantic	5.7	+ 0.9	Northern Slope	3.9	+ 0.1
South Atlantic	5.4	+ 0.4	Middle Slope	4.9	+ 0.9
Florida Peninsula	5.5	+ 0.5	Southern Slope	3.7	— 0.1
East Gulf	4.9	— 0.1	Southern Plateau	2.3	— 1.0
West Gulf	4.0	— 0.2	Middle Plateau	2.5	+ 0.5
Ohio Valley and Tennessee	5.1	+ 0.5	Northern Plateau	2.3	— 0.8
Lower Lake	5.6	+ 1.1	North Pacific	4.3	— 0.1
Upper Lake	5.6	+ 0.9	Middle Pacific	2.5	— 0.4
North Dakota	4.3	0.0	South Pacific	2.9	+ 0.2
Upper Mississippi Valley	5.2	+ 0.9			

The distribution of clear sky is graphically shown on Chart IV, and the numerical values of average daylight cloudiness, both for individual stations and by geographic districts, appear in Table I.

HUMIDITY.

The mean monthly relative humidity was normal in the following geographic districts: South Atlantic States, southern Plateau region, and north Pacific coast; below normal in New England, Florida Peninsula, northern Plateau region, and middle Pacific coast; and above normal in the Middle Atlantic and Gulf States, Ohio Valley and Tennessee, Lake region, North Dakota, upper Mississippi Valley, Missouri Valley, slope regions, middle Plateau, and south Pacific coast.

The averages by districts appear in the following table:

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	79	— 1	Missouri Valley	72	+ 6
Middle Atlantic	78	+ 4	Northern Slope	62	+10
South Atlantic	80	0	Middle Slope	66	+ 6
Florida Peninsula	78	— 2	Southern Slope	64	+ 5
East Gulf	80	+ 2	Southern Plateau	38	0
West Gulf	79	+ 5	Middle Plateau	36	+ 4
Ohio Valley and Tennessee	74	+ 5	Northern Plateau	39	— 2
Lower Lake	75	+ 6	North Pacific	75	0
Upper Lake	77	+ 5	Middle Pacific	61	— 2
North Dakota	74	+ 8	South Pacific	67	+ 3
Upper Mississippi Valley	76	+ 8			

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Abilene, Tex	7	58	e.	Mount Tamalpais, Cal	9	50	nw.
Bismarck, N. Dak	16	52	w.	Do	12	54	nw.
Hatteras, N. C	20	58	nw.	Omaha, Nebr	13	64	ne.
Mount Tamalpais, Cal	8	58	nw.				

DESCRIPTION OF TABLES AND CHARTS.

By Mr. WM. B. STOCKMAN, Chief, Division of Meteorological Records.

For description of tables and charts see page 20 of REVIEW for January, 1905.

TABLE I.—*Climatological data for U. S. Weather Bureau stations, July, 1905.*

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.								Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
New England.							68.5	+ 0.6									79	3.12	— 0.5											
Eastport	76	69	82	29.86	29.94	+ .01	59.8	— 0.6	87	10	68	46	1	51	33	56	55	87	2.62	— 1.3	9	5,893	s.	32	e.	30	5	18	8	5.3	
Portland, Me.	103	81	117	29.83	29.95	.00	67.6	— 0.9	91	13	75	51	24	60	30	62	59	76	3.65	+ 0.1	12	6,348	s.	38	nw.	19	12	11	8	6.1	
Concord	288	70	79	29.66	29.96	.00	70.0	+ 0.1	94	18	81	46	22	59	34				2.02	— 1.9	12	3,807	se.	24	n.	19	6	17	8	5.0	
Northfield	876	16	60	29.03	29.96	+ .02	66.1	+ 1.0	88	18	76	43	22	56	33	62	60	78	6.17	+ 2.5	16	5,226	s.	28	sw.	13	2	20	9	5.6	
Boston	125	115	181	29.83	29.96	.00	73.2	+ 1.9	94	19	81	59	22	65	24	65	62	72	1.00	— 2.4	6	6,928	sw.	26	w.	19	14	9	8	4.8	
Nantucket	12	14	90	29.96	29.97	— .01	69.0	+ 1.8	89	19	76	55	6	63	25	65	64	89	4.02	+ 1.6	10	9,979	sw.	48	e.	23	10	15	6	4.9	
Block Island	26	11	46	29.95	29.98	+ .01	69.0	+ 0.6	86	18	75	59	16	63	18	66	64	89	2.59	— 0.6	12	10,086	sw.	48	e.	23	10	12	9	5.3	
Providence	159	57	67	29.81	29.98	+ .01	72.2	.....	96	19	81	55	26	63	26	65	62	75	2.64	.....	10	4,311	w.	19	w.	14	15	8	8	5.0	
Hartford	159	115	132	29.80	29.96	— .01	73.4	.....	95	18	83	55	27	64	27	66	62	73	2.71	.....	12	5,348	s.	29	s.	13	13	10	8	5.1	
New Haven	106	116	154	29.86	29.97	.00	73.0	+ 1.2	95	18	81	56	26	65	27	66	63	76	2.86	— 2.1	11	5,789	s.	40	nw.	19	15	11	5	4.5	
Mid. Atlantic States.							74.6	+ 0.5									78	5.77	+ 1.6											5.7
Albany	97	102	115	29.85	29.95	— .01	73.8	+ 1.4	96	18	83	55	26	64	29	66	62	70	2.00	— 2.0	9	5,764	s.	40	nw.	19	10	14	7	5.4	
Binghamton	875	79	90	29.04	29.95	— .02	70.6	+ 1.9	92	17	80	46	22	61	32				5.24	+ 2.0	17	3,867	s.	27	nw.	24	4	9	18	7.2	
New York	314	108	350	29.64	29.97	— .01	75.4	+ 1.9	96	18	83	61	27	68	25	68	65	76	6.01	+ 1.8	14	7,358	s.	46	w.	19	5	17	9	5.9	
Harrisburg	374	94	104	29.58	29.97	— .01	74.6	+ 1.7	96	18	82	57	26	67	25	67	64	75	5.01	+ 0.8	14	4,531	w.	28	w.	12	8	9	14	6.4	
Philadelphia	117	116	184	29.86	29.97	— .01	76.9	+ 1.2	98	18	84	62	23	69	23	68	65	71	3.11	— 1.1	12	7,239	sw.	35	ne.	20	7	13	11	5.9	
Scranton	805	111	119	29.13	29.97	— .01	72.8	.....	94	17	82	49	26	64	31	67	65	78	2.62	.....	16	4,986	sw.	30	sw.	12	9	8	14	5.8	
Atlantic City	52	39	48	29.93	29.98	.00	73.4	+ 1.5	99	18	79	61	26	68	24	69	66	82	1.67	— 1.8	9	5,782	sw.	23	ne.	23	10	10	11	5.4	
Cape May	17	48	52	29.99	30.01	+ .03	73.0	— 0.6	92	19	78	63	4	68	24	69	.....	.....	2.98	— 0.4	10	5,490	s.	24	e.	22	7	22	2	5.0	
Baltimore	123	69	117	29.85	29.97	— .01	77.0	— 0.2	98	18	85	62	26	69	24	69	66	74	10.65	+ 6.0	17	4,923	sw.	38	s.	12	6	12	13	6.5	
Washington	112	59	76	29.85	29.96	— .04	76.4	— 0.4	95	18	84	60	27	68	25	71	69	82	9.95	+ 5.4	15	4,248	s.	35	nw.	19	8	14	9	5.9	
Lynchburg	681	83	88	29.26	29.99	— .02	76.2	— 1.3	94	19	85	59	26	68	24	70	68	83	6.86	+ 3.0	16	2,314	se.	20	se.	4	10	14	7	5.0	
Mount Weather	1,725	10	57	28.22	29.98	— .01	70.8	.....	90	18	78	58	26	64	22	65	63	84	3.91	.....	14	9,835	nw.	48	nw.	19	14	11	6	4.5	
Norfolk	91	102	111	29.91	30.00	.00	78.8	+ 0.3	94	19	86	67	26	71	22	72	70	79	7.22	+ 1.3	12	5,874	s.	34	ne.	29	5	14	12	6.4	
Richmond	144	144	153	29.85	29.99	— .02	78.4	.....	97	18	87	66	23	70	23	.....	.....	.....	3.25	.....	15	5,402	s.	42	s.	12	11	16	4	4.7	
Wytheville	2,293	40	47	27.69	29.99	— .02	71.3	— 1.0	89	17	80	52	26	62	27	66	64	86	8.54	+ 4.8	18	2,783	w.	24	w.	4	8	18	5	5.1	
S. Atlantic States.							73.5	+ 0.3									80	6.53	+ 0.6											5.4
Asheville	2,255	53	75	27.72	30.00	— .02	72.2	+ 0.7	87	3	81	54	26	63	25	66	64	83	11.71	+ 7.2	19	4,079	se.	28	se.	10	4	17	10	6.2	
Charlotte	773	68	76	29.20	30.01	— .01	78.4	+ 0.2	95	4	87	65	27	70	23	71	68	77	5.77	+ 0.2	20	4,012	s.	30	sw.	24	6	13	12	6.0	
Hatteras	11	12	47	30.01	30.02	+ .01	78.9	+ 1.0	90	20	84	67	26	73	17	75	73	85	4.22	— 2.2	15	8,368	sw.	58	nw.	20	15	15	1	4.0	
Raleigh	376	71	79	29.60	29.99	— .03	79.0	+ 1.9	96	4	88	66	26	70	25	72	70	79	7.65	+ 2.7	19	3,748	s.	31	sw.	21	9	16	6	5.1	
Wilmington	78	82	90	29.91	29.99	— .02	79.4	— 0.3	95	20	87	68	28	72	23	74	72	82	7.42	+ 0.2	19	5,268	sw.	26	sw.	22	5	21	5	5.8	
Charleston	48	14	92	29.97	30.02	— .01	81.2	— 0.6	96	20	87	72	25	76	20	75	73	80	5.70	— 1.9	15	7,215	s.	34	s.	12	9	15	7	5.6	
Columbia, S. C.	351	41	57	29.63	30.00	— .02	80.6	0.0	100	3	90	67	28	72	28	73	70	78	6.90	+ 1.3	14	4,393	s.	36	sw.	4	7	15	9	5.7	
Augusta	180	89	97	29.81	30.00	— .02	81.8	+ 0.7	98	3	91	68	7	72	25	73	71	76	3.11	— 2.2	13	4,258	se.	31	sw.	28	12	15	4	3.6	
Savannah	65	81	89	29.95	30.02	— .01	81.2	— 0.7	96	20	89	70	9	73	22	74	72	81	7.68	+ 1.9	15	4,775	sw.	24	e.	28	5	19	7	6.1	
Jacksonville	43	101	129	29.96	30.02	— .01	82.0	— 0.1	94	20	89	69	17	75	19	75	73	81	5.14	— 1.3	16	6,436	sw.	40	sw.	29	7	15	9	5.6	
Florida Peninsula.							82.2	+ 0.2									78	6.84	+ 1.1											5.5
Jupiter	28	10	48	30.01	30.04	+ .01	81.8	+ 1.0	93	30	88	72	30	76	21	76	74	81	9.12	+ 3.9	18	6,205	se.	36	se.	10	1	24	6	5.9	
Key West	22	10	53	30.00	30.02	— .01	83.2	— 0.7	91	6	88	73	24	79	18	76	73	73	3.58	— 0.3	14	5,741	e.	36	sw.	13	10	14	7	5.3	
Tampa	34	79	96	29.99	30.02	— .02	81.6	+ 0.2	94	2	89	70	14	74	22	75	73	81	7.81	— 0.4	22	4,291	e.	30	n.	12	7	19	5	5.2	
East Gulf States.							79.8	— 1.0									80	4.78	— 0.6											4.9
Atlanta	1,174	190	216	28.80	30.01	— .01	77.9	— 0.5	92	18	86	63	6	70	21	72	71	86	4.64	— 0.3	14	6,424	w.	44	sw.	6	11	15	5	4.9	
Macon	370	93	99	29.62	30.01	— .01	81.0	.....	96	19	90	68	7	72	24	.....	.....	.....	2.57	.....	14	3,731	s.	27	w.	20	10	18	3	4.5	
Pensacola	56	79	96	29.95	30.02	+ .01	80.6	— 0.2	93	15	86	69	7	75	16	.....	.....	.....	5.02	— 1.7	10	7,226	sw.	42	s.	7	15	9	7	4.7	
Birmingham	700	136	143	29.25	30.00	— .01	78.6	— 2.1	93	19	87	64	26	70	23	.....	.....	.....	4.57	— 0.8	12	4,309	sw.	39	e.	10	5	21	5	5.5	
Mobile	57	88	96	29.94	30.00	— .01	81.5	+ 0.3	95	15	90	67	6	73	22	74	72	78	9.18	+ 2.6	17	4,129	s.	26	e.	16	8	18	5	4.9	
Montgomery	223	100	112	29.76	30.00	— .02	81.0	— 0.5	95	28	91	67	7	71	25	73	70	78	2.54	— 2.0	10	4,294	sw.	28	s.	10	14	11	6	4.5	
Meridian	375	84	93	29.60	29.98	— .04	78.4	— 1.6	93	15	88	63	7	69	26	.....	.....	.....	3.93	— 1.5	13	3,234	sw.	25	w.	23	13	9	9	4.9	
Vicksburg	247	62	74	29.70	29.97	— .03	78.8	— 2.5	97	16	86	65	7	71	24	73	71	81	4.47	0.0	11	4,475	sw.	28	nw.	8	7	11	13	5.7	
New Orleans	51	88	121	29.94	29.99	— .01	81.6	— 0.6	94	15	89	66	10	74	22	74	71	76	3.93	— 2.5	11	5,094	sw.	32	n.	4	10	15	6	4.9	
West Gulf States.							79.7	— 2.2									79	5.28	+ 2.2											4.0
Shreveport	249	77	84	29.70	29.97	— .01	79.7	— 2.8	95	31	88	64	6	71	26	72	70	79	13.16	+ 9.6	14	4,015	s.	24	n.	5	12	7	12	5.1	
Fort Smith	457	79	94	29.46	29.93	— .04	77.0	— 3.0	94	15	86	61	11	68	24	71	68	79	8.45	+ 4.0	13	5,298	e.	43	nw.	2	2	22	7	5.5	
Little Rock	357	93	100	29.58	29.94	— .05	77.3	— 3.0	92	17	85	62	7	70	21	72	70	82	3.63	— 0.4	15	5,020	sw.	34	nw.	3	5	17	9	6.0	
Corpus Christi	20	48	53	29.94	29.96	.00	81.5	— 0.2	90	31	87	65	11	76	19	76	74	82	1.63	+ 0.3	5	9,247	se.	31	s.	8	20	9	2	2.7	
Fort Worth	670	106	114	29.26	29.96	.00	79.4	.....	97	15	89	56	10	70	27	.....	.....	.....	8.35	.....	10	7,360	s.	48	w.	4	21	6	4	3.5	
Galveston	54	106	112	29.93	29.99	+ .01	82.0	— 1.9	92	17	86	68	9	78	16	76	74	79	2.39	— 0.7	4	7,937	s.	38	e.	6	17	13	1	3.1	
Palestine	510	73	79	29.44	29.96	— .01	78.9	— 2.6	94	31	88	60	10	70	22	72	70	81	4.87	+ 2.3	13	5,042	s.	34	w.	5	12	13	6	4.4	
San Antonio	701	80	91	29.22	29.93	— .02	81.2	— 2.1	100	31	92	60	11	70	29	72	69	72	2.82	+ 0.6	6	4,625	se.	48	nw.	3	26	4	1	2.7	
Taylor	583	55	63	29.35	29.96	.00	81.2	.....	101	31	91	60	11	71	27	.....	.....	.....	1.38	.....	4	6,742	s.	29	s.	2	21	9	1	2.8	
Ohio Val. and Tenn.							75.7	— 0.7									74	3.49	— 0.6											5.1
Chattanooga	762	106	112	29.21	30.00	— .02	77.6	— 0.2	92	20	87	61	26	68	25	70	67	74	2.39	— 1.8	13	4,331	sw.	36	s.	10	8	16	7	5.5	
Knoxville	1,004	35	88	28.96	29.99	— .03	76.5	+ 0.1	92	17	86	58	26	67	25	70	67	79	3.23	— 1.1	17	4,192	sw.	40	w.	2	7	18	6	5.2	
Memphis	399	76	97	29.56	29.98	— .02	77.8	— 2.9	93	17	85	64	6	71	17	71	68	76	4.51	+ 1.0	14	6,029	sw.	46	w.	3	10	14	7	4.5	
Nashville	546	79	91	29.42	29.99	— .02	77.7	— 1.6	93	18	86	60	26	69	23	70	67	73	3.23	— 1.1	10	4,136	sw.	30	sw.	3	12	15	4	4.3	
Lexington	989	75	102	28.93	29.97	— .04	74.6	— 0.8	90	17	83	58	25	66	20	.....	.....	.....	4.94	— 0.2	14	5,886	sw.	40	se.	10	10	18	3	4.3	
Louisville	525	114	136	29.41	29.98	— .02	77.4	— 1.0	96	16	86	59	26	69	23	69	65	72	5.13	+ 1.4	15	4,860	sw.	32	se.	10	9	13	9	5.9	
Evansville	431	72	82	29.48	29.94	— .06	76.6	.....	93	17	84	61	25	69	20	.....	.....	.....	8.51	.....	15	4,697	s.	31	s.	4	10	18	3	4.8	
Indianapolis	822	154	164	29.08	29.95	— .04	73.8	— 2.4	92	18	82	55	25	66	22	66	63	73	2.29	— 2.0	13	6,487	s.	43	sw.	4	2	25	4	5.8	
Cincinnati	628	152	160	29.30	29.96	— .04	76.6	— 0.8	94	16	85	59	25	68	24	67	63	66	1.04	— 2.3	10	4,252	sw.	28	nw.	23	6	16	9	6.0	
Columbus	824	173	190	29.10	29.96	— .04	74.9	0.0	94	17	84	55	25	66	28	67	63	72	2.27	— 1.0	12	6,754	sw.	40	sw.	4	12	8	11	5.2	
Pittsburg	842	336	352	29.08	29.96	— .04	74.6	— 0.4	93	18	83	58	27	66	29	66	63	72	3.01	— 1.7	13	6,593	sw.	38	sw.	5	9	14	8	5.2	
Parkersburg	638	77	84	29.33	29.98	— .03	75.5	+ 0.7	95	17	85	57	26	66	28	68	66	78	5.26	+ 0.6	12	3,440	s.	33	w.	6	17	10	4	3.5	
Elkins	1,940	41	80	28.01	29.99	— .02	71.1	+ 1.3	92	4	81	48	26	61	30	65	63	84	4.56	+ 0.4	19	2,071	s.	23	w.	7	8	12	11	5.7	
Lower Lake Region.							71.5	+ 0.3									75	5.18	+ 0.1											5.0
Buffalo	767	178	206	29.12	29.93	— .04	70.8	+ 1.1	88	4	77	54	22	64	26	65	61	75	2.38	— 0.8	14	9,074	sw.	44	w.	24	1	20	10	7.1	
Oswego	335	76	91	29.57	29.93	— .03	68.6	— 0.4	87	12	76	53	22	62	24	64	62	80	3.04	— 0.1	14	6,445	s.	26	ne.	31	7	15	9	5.7	
Rochester	523	81	102	29.39	29.95	— .02	72.2	+ 1.8	92	18	81	54	22	64	28	66	63	78	3.82	+ 0.8	15	5,688	sw.	30	sw.	24	4	14	13	6.6	
Syracuse	597	97	113	29.31	29.95	— .02	70.8	.....	89	18	78	53	22	63	27	.....	.....	.....	4.46	.....	12	8,047	s.	43	sw.	12	6	17	8	5.6	
Erie	713	92	102	29.18	29.93	— .05	71.8	+ 0.8	88	4	78	59	26	66	21	65	61	71	3.68	+ 0.9	15	6,915	s.	27	w.	24	4	16	11	6.3	
Cleveland	762	190	201	29.14	29.94	— .05	71.8	+ 0.3	88	17	78	58	27	66	26	66	63	75	4.08	+ 0.6	15	9,231	se.	41	sw.	17	7	18	6	5.1	
Sandusky	629	62	70	29.27	29.94	— .05	73.2	+ 0.1	92	17	81	55	26	65	27	.....	.....	.....	3.11	0.0	15	5,314	sw.	40	nw.	19	12	12	7	4.8	
Toledo	628	120	127	29.28	29.95	— .04	72.4	— 1.0	93	17	81	53	25	64	27	65	61	71	1.85	— 1.1	12	6,514	sw.	35	sw.	4	11	17	3	4.2	
Detroit	730	153	193	29.16	29.93	— .05	71.4	— 0.2	94	18	80	53	25	63	23	65	61	74	3.52	+ 0.2	12	7,494	w.	40	nw.	14	7	19	5	5.4	
Upper Lake Region.							66.4	— 1.3									77	3.94	+ 0.9											5.6
Alpena	609	13	92	29.28	29.94	— .03	66.1	+ 0.8	93	18	75	47	21	57	31	61	58	78	3.93	+ 1.0	13	6,701	se.	37	sw.	17	9	15	7	5.1	
Escanaba	612	40	48	29.27	29.92	— .05	63.7	— 3.0	86	19	72	42	21	55	31	59	56	77	4.39	+ 1.2	13	4,881	s.	31	sw.	17	12	11	8	4.7	
Grand Rapids	707	127	165	29.18	29.93	— .05	70.7	— 2.6	91	18	80	52	27	62	31	64	60	74	5.33	+ 3.0	11	7,027	sw.	43	sw.	4	6	13	12	5.9	
Houghton	668	66	74	29.19	29.91	— .05	63.8	.....	84	17	73	41	31	55	31	.....	.....	.....	3.85	.....	12	4,860	e.	25	nw.	16	17	6	8	4.2	
Marquette	734	76	116	29.14	29.94	— .02	62.2	— 2.7	90	18	71	45	31	54	31	57	53	75	2.00	— 1.0	13	5,863	nw.	34	sw.	16	6	12	13	6.1	
Port Huron	638	70	120	29.27	29.96	— .02	68.9	+ 0.4	92	17	77	53	25	61	26	64	61	77	4.17	+ 1.8	15	7,438	sw.	35	sw.	4	10	14	7	5.2	
Sault Ste. Marie	614	40	61	29.25	29.94	— .03	63.0	+ 1.2	86	18	72	44	10	54	31	58	56	80	2.73	— 0.2	11	5,253	nw.	30	nw.	24	9	11	11	6.0	
Chicago	823	140	310	29.06	29.93	— .05	71.2	— 0.8	95	18	78	56	24	64	24	64	61	74	5.02	+ 1.5	14	9,361	sw.	40	sw.	4	5	17	9	6.2	
Milwaukee	681	124	142	29.22	29.95	— .02	68.0	— 1.2	94	18	76	52	2	60	27	62	58	76	2.52	— 0.6	12	7,261	n.	32	n.	17	9	9	13	5.8	
Green Bay	617	49	86	29.26	29.92	— .05	67.2	— 2.8	93	18	76	51	25	59	28	63	60	81	5.26	+ 1.9	14	6,554	ne.	47	nw.	17	3	9	19	7.1	
Duluth	1,133	11	47	28.73	29.93	— .02	62.6	— 2.1	85	16	71	47	31	54	31	58	55	79	4.02	+ 0.3	13	8,782	ne.	40	ne.	3	7	15	9	5.6	

TABLE I.—*Climatological data for U. S. Weather Bureau stations, July, 1905*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.								Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.			Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
North Dakota.							66.0	— 2.5									74	3.42	+ 0.6									4.3	
Moorhead	935	8	57	28.96	29.96	+ .02	66.3	— 1.3	90	15	77	44	8	56	27	62	69	81	5.16	+ 1.2	8	4,545	n.	36	nw.	15	16	8	7	4.0	
Bismarck	1,674	16	57	28.22	29.98	+ .05	66.8	— 2.7	91	14	78	43	31	56	30	60	56	72	3.24	+ 0.8	10	6,500	nw.	52	w.	16	18	11	2	4.0	
Devils Lake	1,482	11	44	28.41	29.96	+ .03	64.6	.....	87	10	76	40	8	53	29	59	56	75	6.89	.....	9	7,526	nw.	37	nw.	14	13	12	6	4.5	
Williston	1,875	14	44	28.01	29.96	+ .04	65.0	— 3.5	86	10	76	40	23	54	35	59	55	70	1.94	— 0.2	10	6,349	se.	37	nw.	4	11	10	10	4.8	
Upper Miss. Valley.							72.5	— 2.6									76	3.00	— 0.3									5.2	
Minneapolis	.....	102	208	.....	.....	.....	69.8	— 1.8	93	16	78	54	9	62	23	.....	.....	.....	3.02	— 0.8	9	7,659	n.	36	s.	15	8	14	9	5.5	
St. Paul	837	171	179	29.03	29.92	— .03	70.2	— 1.3	94	16	78	54	23	62	24	63	59	71	2.71	— 0.6	7	6,416	n.	35	nw.	17	13	11	7	4.6	
La Crosse	714	71	87	29.15	29.90	— .06	71.2	— 1.7	95	16	80	55	10	63	25	.....	.....	.....	2.72	— 1.4	9	4,550	n.	26	nw.	22	9	16	6	4.8	
Madison	974	70	78	28.89	29.91	— .06	69.2	.....	91	17	78	54	25	61	29	63	60	76	2.27	— 1.9	10	6,073	sw.	39	ne.	17	9	18	4	4.6	
Charles City	1,015	8	58	28.87	29.93	— .03	69.0	.....	95	17	79	50	10	59	28	63	61	79	1.19	— 2.7	9	4,028	nw.	23	nw.	4	10	13	8	5.1	
Davenport	606	71	79	29.27	29.92	— .05	72.0	— 3.0	93	17	80	54	24	64	27	66	64	78	0.99	— 2.7	8	4,588	nw.	25	nw.	4	11	11	9	5.2	
Des Moines	861	84	101	29.04	29.94	— .02	71.0	— 3.5	94	16	80	54	25	62	24	65	61	75	4.53	+ 1.0	10	5,135	n.	34	se.	19	6	17	8	6.0	
Dubuque	698	100	117	29.20	29.93	— .04	71.4	— 2.9	94	17	80	52	25	63	26	65	62	75	1.51	— 2.8	12	4,296	n.	30	nw.	22	9	10	12	6.0	
Keokuk	614	63	78	29.26	29.92	— .06	73.3	— 3.6	94	18	81	56	24	65	25	67	65	81	2.89	— 1.2	12	4,450	sw.	36	sw.	2	14	8	9	4.7	
Cairo	356	87	93	29.58	29.95	— .05	75.8	— 3.1	92	16	83	61	7	69	19	70	69	82	4.43	+ 1.0	17	4,903	sw.	28	nw.	23	4	18	9	6.1	
La Salle	536	56	64	29.36	29.92	— .05	72.1	.....	94	18	82	53	25	63	33	.....	.....	.....	1.49	.....	10	4,909	sw.	26	sw.	4	13	14	4	4.0	
Peoria	609	11	45	29.28	29.94	— .04	72.0	.....	93	18	82	52	25	62	28	.....	.....	.....	4.24	.....	15	4,906	s.	28	sw.	4	16	11	4	4.3	
Springfield, Ill.	644	82	93	29.26	29.94	— .04	74.1	— 1.9	93	18	84	55	24	65	24	67	63	75	3.99	+ 1.2	14	5,339	sw.	31	se.	2	7	15	9	5.6	
Hannibal	534	75	109	29.36	29.92	— .06	73.8	— 2.9	95	15	83	55	25	65	27	.....	.....	.....	4.33	— 0.2	12	5,430	sw.	34	sw.	4	11	7	13	5.9	
St. Louis	567	208	217	29.34	29.93	— .06	75.4	— 3.4	94	18	83	61	10	68	25	67	64	72	4.42	+ 0.7	11	6,674	sw.	39	sw.	2	7	11	13	6.0	
Missouri Valley.							71.7	— 3.4									72	4.27	+ 1.1									5.0	
Columbia, Mo	784	11	84	29.12	29.92	— .06	73.2	— 3.2	94	16	83	53	25	64	28	.....	.....	.....	4.05	— 0.2	12	4,414	s.	42	w.	2	12	10	9	5.3	
Kansas City	963	78	95	28.95	29.96	— .01	74.4	— 3.1	94	16	82	58	9	66	24	67	63	72	7.35	+ 3.2	13	4,495	se.	29	sw.	3	12	10	9	4.8	
Springfield, Mo	1,324	98	104	28.57	29.95	— .03	71.9	— 3.8	88	17	79	59	11	65	21	67	64	80	13.12	+ 8.8	18	5,964	s.	35	n.	20	15	6	10	4.7	
Topeka	.....	85	89	.....	.....	.....	74.1	— 3.3	94	16	83	56	9	65	30	.....	.....	.....	6.53	+ 1.6	11	5,133	s.	31	s.	2	12	14	5	4.3	
Lincoln	1,189	75	84	28.68	29.92	— .03	72.6	— 4.2	99	16	83	50	9	62	32	65	61	70	3.25	— 0.6	13	6,380	s.	46	nw.	4	9	15	7	4.8	
Omaha	1,105	115	121	28.78	29.93	— .02	72.6	— 3.6	95	16	81	54	9	64	27	64	60	68	2.36	— 2.4	10	5,514	n.	64	ne.	13	10	10	11	5.5	
Valentine	2,598	47	54	27.29	29.97	+ .04	69.1	— 4.2	98	17	80	46	9	58	32	60	56	70	4.31	+ 1.8	13	7,136	e.	48	nw.	2	8	20	3	4.6	
Sioux City	1,135	96	164	28.74	29.92	— .03	70.6	— 3.7	100	16	81	48	10	61	28	.....	.....	.....	1.41	— 2.0	6	7,381	nw.	39	nw.	4	10	12	9	5.2	
Pierre	1,572	43	50	28.33	29.97	+ .04	71.4	— 3.2	97	17	82	54	*	61	32	63	59	71	4.81	+ 2.6	11	5,093	se.	48	sw.	4	12	11	8	4.9	
Huron	1,306	56	67	28.58	29.96	+ .02	68.6	— 2.3	94	15	80	48	24	58	30	62	59	75	5.27	+ 2.2	11	70,18	se.	37	nw.	3	12	14	5	4.5	
Yankton	1,233	55	65	28.63	29.93	— .01	70.6	— 3.0	97	16	81	48	24	60	30	.....	.....	.....	1.12	— 2.7	7	5,556	nw.	36	nw.	3	7	9	15	6.1	
Northern Slope.							67.9	— 1.5									62	2.90	+ 1.3									3.9	
Havre	2,505	11	44	27.36	29.94	+ .03	69.8	+ 2.3	98	10	84	49	12	56	44	58	52	60	0.86	— 1.4	10	5,910	e.	40	n.	11	21	10	0	2.8	
Miles City	2,371	42	50	27.47	29.97	+ .05	72.1	— 1.6	94	10	84	54	*	60	36	61	55	61	3.37	+ 2.0	13	4,472	n.	36	n.	22	13	16	2	3.8	
Helena	4,110	8	56	25.86	29.97	+ .04	67.6	+ 0.4	93	21	81	46	17	54	38	53	44	50	1.05	— 0.1	10	4,871	sw.	35	sw.	31	17	11	3	3.1	
Kalispell	2,962	11	34	26.93	29.92	— .01	65.8	.....	93	21	82	40	15	50	42	53	44	56	0.56	.....	6	3,969	w.	26	w.	15	23	7	1	2.3	
Rapid City	3,234	46	50	26.64	29.99	+ .06	66.7	— 4.6	91	14	76	50	10	57	34	60	57	74	9.66	+ 8.0	18	1,991	se.	22	n.	7	8	11	12	5.9	
Cheyenne	6,088	56	64	24.11	29.96	+ .04	63.8	— 3.1	88	17	77	42	9	50	37	54	49	67	2.97	+ 1.2	15	5,603	nw.	35	nw.	4	9	16	6	5.0	
Lander	5,372	26	36	24.72	29.96	+ .04	65.2	— 0.8	90	13	82	40	3	49	47	53	45	57	0.47	— 0.5	10	2,821	sw.	30	sw.	26	9	20	2	4.8	
Yellowstone Park	6,200	11	47	23.98	29.99	+ .07	59.8	.....	84	10	75	36	3	44	42	47	39	57	1.38	.....	9	4,742	sw.	33	nw.	23	16	14	1	3.4	
North Platte	2,821	43	52	27.10	29.97	+ .04	70.4	— 3.1	96	15	82	46	9	59	32	62	59	72	2.58	— 0.2	16	5,979	se.	42	nw.	2	17	7	7	3.9	
Middle Slope.							73.5	— 2.8									66	4.26	+ 1.3									4.0	
Denver	5,291	129	136	24.81	29.97	+ .06	69.0	— 2.7	94	14	82	47	8	56	37	54	46	55	1.55	— 0.2	9	5,371	s.	48	ne.	8	10	15	6	4.9	
Pueblo	4,685	80	86	25.35	29.95	+ .04	71.4	— 2.6	96	17	86	47	8	57	39	57	48	55	2.09	— 0.1	12	4,831	se.	32	n.	27	9	18	4	4.9	
Concordia	1,398	42	47	28.51	29.95	.00	73.8	— 3.3	95	16	84	51	11	63	31	66	62	72	6.43	+ 2.8	12	4,122	e.	29	e.	19	9	18	4	5.0	
Dodge	2,509	44	54	27.41	29.95	+ .02	73.8	— 3.8	97	15	86	46	10	61	38	64	59	69	5.75	+ 2.6	9	6,575	se.	46	se.	29	13	14	4	4.8	
Wichita	1,358	78	86	28.55	29.95	— .01	76.0	— 2.4	98	15	86	53	10	66	28	67	63	69	5.39	+ 2.2	7	4,902	se.	32	s.	29	11	17	3	4.5	
Oklahoma	1,214	79	86	28.67	29.91	— .05	77.0	— 2.0	95	30	86	56	10	68	26	69	66	74	4.37	+ 0.7	11	6,418	s.	46	nw.	2	7	18	6	5.5	
Southern Slope.							77.0	— 2.4									64	4.50	+ 2.0									3.7	
Abilene	1,738	45	54	28.17	29.92	— .01	80.3	— 2.4	101	5	91	55	10	69	30	69	64	63	5.24	+ 3.5	6	5,499	s.	58	e.	7	14	11	6	4.1	
Amarillo	3,676	10	49	26.29	29.94	+ .02	73.6	— 2.4	94	12	85	51	9	62	36	63	58	66	3.76	+ 0.4	9	5,545	se.	34	ne.	28	21	5	5	3.2	
Roswell	3,578	9	57	26.37	29.92	+ .04	75.0	.....	101	12	89	53	5	61	46	62	55	62	4.97	.....	9	3,942	se.	24	nw.	3	17	6	8	3.7	
Southern Plateau.							77.9	— 2.1									38	1.20	— 0.1									2.3	
El Paso	3,762	10	110	26.18	29.85	+ .01	79.0	— 2.9	102	5	91	59	5	67	43	61	49	46	2.55	+ 0.5	8	7,175	ne.	43	sw.	14	19	7	5	3.3	
Santa Fe	7,013	33	39	23.36	29.88	.00	66.0	— 2.5	85	12	77	48	3	54	34	52	41	48	1.98	— 0.8	13	4,786	ne.	30	e.	8	15	14	2	3.7	
Flagstaff	6,907	12	44	23.45	29.86	+ .03	64.0	— 3.7	92	7	80	36	2	48	46	49	37	46	2.42	+ 0.6	9	5,014	n.	43	sw.	1	14	13	4	3.4	
Phoenix	1,108	50	56	28.64	29.75	— .03	89.6	— 0.6	116	6	105	66	15	74	43	64	46	29	0.28	— 0.8	3	3,829	e.	30	n.	23	20	10	1	2.3	
Yuma	141	16	46	29.61	29.75	— .01	89.2	— 2.3	116	6	104	66	16	74	41	70	59	44	T.	— 0.1	9	4,987	sw.	26	se.	25	26	5	0	0.8	
Independence	3,910	11	42	25.94	29.82	— .01	79.8	— 0.5	102	7	96	54	16	64	38	54	28	17	0.00	— 0.1	0	5,452	nw.	30	se.	14	31	0	0	0.4	
Middle Plateau.							73.3	+ 0.5									36	0.32	— 0.1									2.5	
Carson City	4,720	82	92	25.30	29.89	+ .02	69.4	+ 1.4	99	7	87	44	17	52	44	52	39	39	0.00	— 0.2	0	4,713	sw.	31	w.	12	30	1	0	0.6	
Winnemucca	4,344	18	56	25.60	29.90	.00	72.4	+ 1.0	100	10	92	45	14	53	48	50	33	28	T.	— 0.2	0	4,318	sw.	23	sw.	15	26	5	0	1.4	
Modena	5,479	10	43	24.64	29.86	.00	71.0	— 0.3	97	6	88	44	16	54	47	51	33	34	0.81	+ 0.4	4	8,711	w.	45	sw.	15	17	12	2	3.4	
Salt Lake City	4,366	105	110	25.60	29.87	— .03	76.9	+ 1.4	97	27	89	53	2	65	34	55	38	28	0.62	+ 0.1	2	4,796	se.	29	e.	21	22	7	2	2.1	
Durango	6,546	18	56	23.74	29.90	+ .01	65.8	.....	89	11	83	40	3	49	44	50	40	51	1.41	.....	13	4,679	nw.	33	s.	14	15	13	3	3.9	
Grand Junction	4,608	45	51	25.38	29.89	.00	76.8	— 1.0	97	12	91	52	2	63	37	56	43	35	0.16	— 0.4	3	4,175	nw.	30	nw.	1	17	13	1	3.5	
Northern Plateau.							73.6	+ 2.6									39	0.25	— 0.2									2.3	
Baker City	3,471	78	86	26.46	29.97	+ .02	69.0	+ 3.0	98	22	84	42	17	54	38	52	39	40	0.18	— 0.4	3	3,879	nw.	22	ne.	15	23	7	1	2.2	
Boise	2,739	61	68	27.11	29.90	— .03	74.9	+ 1.8	103	23	90	49	17	59	38	55	39	33	0.01	— 0.2	1	4,268	se.	41	ne.	19	21	10	0	2.3	
Lewiston	757	10	51	29.12	29.91	— .04	77.0	+ 3.0	108	21	93	51	14	61	42	.....	.....	.....	0.03	— 0.5	2	4,325	e.	46	w.	15	28	3	0	1.0	
Pocatello	4,483	46	54	25.50	29.90	— .02	72.1	+ 1.8	96	23	87	47	3	57	43	52	36	33	0.85	+ 0.4	6	5,479	e.	36	sw.	31	14	15	2	3.6	
Spokane	1,929	101	110	27.94	29.94	— .02	71.1	+ 2.1	103	21	86	46	17	57	42	56	44	46	0.06	— 0.6	2	4,252	e.	26	w.	15	20	8	3	2.7	
Walla Walla	1,000	71	79	28.87	29.92	— .05	77.8	+ 3.8	111	21	92	51	14	63	39	61	49	41	0.36	+ 0.1	2	4,258	s.	27	se.	31	29	2	0	1.8	
N. Pac. Coast Reg.							62.2	+ 0.9									75	0.23	— 0.7									4.3	
North Head	211	11	56	29.87	30.09	+ .01	57.0	— 1.5	96	8	60	49	21	54	38	54	52	87	0.48	— 0.6	7	10,801	nw.	38	nw.	17	7	8	16	6.8	
Port Crescent	259	12	29	29.80	30.08	+ .02	55.9	— 0.4	84	8	62	43	18	50	35	.....	.....	.....	0.22	— 0.3	2	3,383	w.	16	w.	27	16	6	9	4.3	
Seattle	123	185	224	29.93	30.06	+ .02	64.6	+ 0.5	90	8	74	52	7	56	30	58	54	73	0.36	— 0.3	3	4,753	w.	27	n.	7	13	12	6	4.4	
Tacoma	213	113	120	29.82	30.04	— .02	64.8	+ 2.8	94	8	76	50	15	54	39	.....	.....	.....	0.34	— 0.4	3	3,534	n.	21	sw.	13	14	12	5	4.4	
Tatoosh Island	86	7	57	29.96	30.06	+ .01	55.4	— 0.1	80	8	50	49	18	51	30	53	52	92	0.07	— 2.0	5	8,272	sw.	47	ne.	8	4	9	18	7.1	
Portland, Oreg.	153	68	96	29.85	30.01	— .04	68.5	+ 2.2	99	8	80	51	14	57	36	59	53	64	0.12	— 0.5	2	3,846	nw.	17	ne.	8	20	8	3	2.9	
Roseburg	498	56	60	29.45	29.98	— .05	69.0	+ 2.7	106	8	85	43	2	53	50	57	49	59	0.00	— 0.5	0	2,983	nw.	17	n.	10	31	0	0	0.4	
Mid. Pac. Coast Reg.							63.0	+ 0.8									61	T.	0.0									2.5	
Eureka	62	62	80	29.96	30.03	— .02	56.6	+ 0.8	73	8	60	50	11	53	20	54	52	87	0.02	— 0.1	2	4,373	nw.	25	n.	10	5	11	15	6.5	
Mount Tamalpais	2,375	11	18	27.52	29.94	— .01	71.4	.....	99	7	79	46	11	64	36	58	47	45	0.00	.....	0	10,746	nw.	58	nw.	8	28	3	0	0.6	
Red Bluff	332	50	56	29.50	29.84	— .05	82.8	+ 1.0	113	9	99	55	15	67	37	61	44	32	0.00	0.0	0	3,418	s.	16	n.	7	29	2	0	0.5	
Sacramento	69	106	117	29.79	29.86	— .02	72.9	+ 0.3	110	8	88	51	26	58	37	60	52	58	0.00	0.0	0	6,838	s.	22	s.	15	31	0	0	0.3	
San Francisco	155	161	167	29.80	29.97	+ .02	59.5	+ 1.2	98	7	66	49	22	53	34	54	51	81	0.00	0.0	0	9,193	w.	37	w.	28	10	16	5	4.4	
S. Pac. Coast Reg.							70.4	— 0.3									67	0.05	0.0									2.9	
Fresno	330	67	70	29.50	29.84	+ .01	82.4	+ 0.9	115	8	101	54	15	64	41	59	39	30	0.00	0.0	0	5,131	nw.	22	nw.	10	31	0	0	0.1	
Los Angeles	338	116	123	29.55	29.90	.00	69.2	— 0.1	86	7	78	54	2	60	31	62	50	79	0.00	0.0	0	3,989	w.	21	w.	15	10	19	2	3.9	
San Diego	87	94	102	29.81	29.90	— .02	65.2	— 1.9	74	5	69	59	24	62	13	61	60	84	0.16	+ 0.2	1	4,232	sw.	19	w.	16	20	3	8	4.6	
San Luis Obispo	201	47	54	29.73	29.94	— .01	64.6	— 0.1	103	8	77	44	1	52	49	56	52	74	0.03	0.0	1	3,538	nw.	17	n.	3	11	17	3	3.7	
West Indies.																														
Grand Turk	11	6	20	30.03	30.04	+ .02	81.9	.....	87	31	90	80	*	74	16	.....	.....	.....	0.78	.....	8	.....	e.	.....	.....	.....	.....	.....	.....	.....	
Havana	57	87	105	29.95	30.01	+ .01	81.6	— 0.8	91	9	88	72	11	75	16	.....	.....	.....	2.45	— 2.6	7	6,664	e.	38	ne.	24	17	11	3	3.8	
San Juan	82	48	90	29.94	30.02	+ .03	80.2	— 1.1	87	31	85	70	10	75	13	75	73	77	7.60	+ 1.9	13	9,149	e.	31	e.	2	8	13	10	5.5	

* More than one date.

TABLE II.—*Climatological record of cooperative observers, July, 1905.*

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Alabama.	°	°	°	*Ins.*	*Ins.*
Alaga				5.10	
Anniston	93[1]	57	76.3[e]	5.92	
Ashville	92	58	76.7	3.79	
Benton				7.00	
Bermuda	97	63	80.7	2.81	
Boligee	98	63	80.6	1.96	
Bridgeport				5.69	
Burkeville				5.80	
Calera				4.96	
Camp Hill	95	55	79.5	4.48	
Cedar Bluff				6.95	
Citronelle	94	64	80.0	6.24	
Clanton	95[d]	61[e]	79.5[d]	3.08	
Cordova	95	59	78.4	6.72	
Dadeville				4.10	
Daphne	99	63	81.4	4.18	
Decatur	92[e]	61[e]	77.4[e]	3.96	
Delmar	93	60	76.5	7.55	
Demopolis				3.62	
Eufaula	93	66	80.0	5.19	
Evergreen	95	61	80.2	4.24	
Flomaton	98	64	81.8	6.83	
Florence	94	58	78.0	3.76	
Fort Deposit	96	68	81.5	5.56	
Gadsden	100	59	80.0	2.12	
Goodwater	97	62	79.4	6.23	
Greensboro	95[f]	67[f]	80.8[f]	2.23	
Greenville				5.69	
Guntersville				5.79	
Hamilton	95[e]	57[e]	78.2[e]	4.81	
Highland Home	96	66	80.0	5.35	
Letohatchie				5.23	
Livingston	95	66	80.4	4.44	
Lock No. 4	95	60	78.8	3.69	
Lucy	95	61	80.0	5.60	
Madison Station	96	59	78.4	3.02	
Maplegrove	99	57	79.0	3.10	
Marion	98	66	81.2	5.59	
Milstead				3.54	
Newbern	100	65	81.0	2.61	
Notasulga				1.08	
Oneonta	95	57	76.9	5.34	
Opelika	99	67	82.4	1.94	
Ozark	95	66	79.0	2.89	
Prattville	96	64	81.0	2.92	
Pushmataha	98	62	80.2	3.32	
Riverton	96	55	76.6	2.16	
Scottsboro	92	57	75.7	2.47	
Selma	101	67	82.2	6.48	
Talladega	98[e]	60[b]	78.8[e]	5.00	
Tallassee				3.69	
Thomasville	103	65	82.5	4.73	
Tuscaloosa	98	64	80.4	3.90	
Tuscumbia	96	63	79.9	4.83	
Tuskegee	97	68	81.4	7.58	
Union Springs	97	67	81.7	4.13	
Uniontown	96	62	78.1	4.27	
Valleyhead	94	58	76.5	4.19	
Vienna				2.07	
Wetumpka	97	64	80.8	7.04	
Alaska.					
Chestochena	80	37	57.0	3.19	
Fort Liscum	75	42	55.4	3.49	
Killisnoo	71	41	55.0	1.60	
Ketchumstock	83	31	55.2	0.40	
Orca	84	43	59.1	4.42	
Sitka	73	44	56.4	2.83	
Skagway	83	43	59.4	0.16	
Arizona.					
Allaire Ranch				1.04	
Alpine				3.95	
Arizona Canal Co. Dam	119	64	90.2	T.	
Aztec	125	65	96.2	0.00	
Benson	108	51	77.0	1.30	
Blue	103	44	71.5	2.91	
Bowie	110	65	87.1	1.20	
Buckeye	121	51	86.8	0.28	
Casagrande	122	68	95.6	0.36	
Cochise[*1]	109	53	76.1	2.22	
Congress	109	67	87.8	0.52	
Douglas	111	58	81.1	1.74	
Dudleyville	109	56	82.2	0.38	
Duncan	109	49	77.4	1.25	
Fort Apache	99	44	70.2	1.66	
Fort Defiance	91	40	64.4	1.11	
Fort Grant	98	59	78.6	0.13	
Fort Huachuca	101	46	73.6	1.19	
Fort Mohave	124	65	92.5	0.07	
Gilabend	120	68	91.8	0.34	
Globe	110	63	82.8	1.26	
Greaterville	100	57	75.6	2.05	
Greer				2.12	
Holbrook	102	46	73.8	1.65	
Huachuca Res				1.91	
Jerome	104	60	80.6	2.60	
Kingman	109	53	82.4	0.15	
Maricopa	122	60	92.0	0.33	
Mesa	118	58	88.9	0.08	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Arizona—Cont'd.	°	°	°	*Ins.*	*Ins.*
Mohawk Summit[*1]	126	85	100.3	0.00	
Natural Bridge				1.20	
Nutrioso				1.29	
Oracle	102	65	82.8	0.48	
Oro				1.25	
Parker	127	61	90.7	0.00	
Phoenix	113	59	86.5	0.17	
Picacho[*1]	115	80	92.4	0.69	
Pinal Ranch				2.64	
Pinto				0.70	
Prescott	104	42	74.0	0.11	
Russellville				T.	
San Carlos	113	55	83.9	0.53	
San Simon	108	55	80.8	0.50	
Seligman	101	43	71.8	1.10	
Sentinel[*1]	122	82	94.5		
Taylor	97	42	71.0	1.90	
Tempe	119	54	87.1	0.20	
Thatcher	107	51	79.8	0.04	
Tombstone	103	60	78.0	3.15	
Tonto	112	58	84.0	0.27	
Tucson	107	62	84.2	1.10	
Upper San Pedro	108	55	78.9	1.00	
Vail[s6]	110	70	91.0	0.04	
Walnut Grove				1.03	
Willcox	110	53	78.0	1.34	
Williams	96	41	67.7	2.20	
Yarnell				0.61	
Young	107	48	79.3	2.99	
Arkansas.					
Alicia	92	60	76.9	8.53	
Amity	92	60	76.1	9.01	
Arkadelphia	96	61	78.3	8.16	
Arnett[f]	88	56	71.9	11.04	
Batesville	91	61	76.1	6.27	
Beebranch	91	55	73.7	7.70	
Blanchard	94	59	77.2	8.63	
Brinkley	97	62	79.0	1.84	
Calico Rock				10.94	
Camden	93	61	78.7	7.19	
Clarendon				4.11	
Conway	95	60	78.7	7.00	
Dallas	90	58	76.0	9.93	
Dardanelle				8.00	
Des Arc	94	60	77.2	4.65	
Dodd City	98	55	73.0	22.35	
Dutton	87	54	70.6	8.91	
Eldorado	96	61	79.0	6.98	
Elon				10.98	
Eureka Springs	91	57	74.0	9.96	
Fayetteville	94	58	73.6		
Forrest City	92	61	76.8	7.35	
Fulton				7.09	
Hardy	92	57	75.5	7.03	
Heber	94	59	77.0	5.51	
Helena	93	64	78.6	3.05	
Hope	99	60	79.4	6.01	
Howe	100	59	79.6	9.16	
Jonesboro	90	58	73.6	6.11	
Lacrosse	106	58	78.0	6.76	
Lake Village	96			4.05	
Lonoke	98	60	78.6	4.06	
Lutherville	93	56	75.8	8.02	
Luxora				5.64	
Malvern	96	60	77.9	6.55	
Marked Tree				3.78	
Marvell	94	61	78.8	6.09	
Mossville	85	55	70.0	19.88	
Mountain Home	91[e]	51[e]	74.0[e]	10.78	
Mount Nebo	88	52	72.8	9.02	
New Lewisville[b]	96	60	77.6		
Newport	99	61	78.8	3.71	
Oregon	92	52	72.2	13.75	
Osceola	94	66	79.6	5.74	
Ozark	94	60	76.3	6.01	
Perry	93	62	78.2	7.17	
Pinebluff	95	62	78.4	7.84	
Pocanontas	95	58	77.6	11.86	
Pond	97	56	73.6	16.47	
Prescott	94	60	79.1	6.36	
Princeton	96	58	78.4	7.31	
Rison	96			7.98	
Russellville	97	61	78.0	10.69	
Silversprings	90	57	72.8	12.17	
Spielerville	94	61	76.7	5.33	
Springbank				6.57	
Stuttgart	94	61	77.8	4.69	
Tate	95	59	77.0	7.82	
Texarkana	96	58	78.0	9.92	
Warren	101	60	78.9	9.02	
White Cliffs				3.85	
Wiggs	93	56	75.7	9.47	
Winchester	96	62	79.6	4.14	
Witts Springs	88	55	70.6	10.25	
California.					
Alturas				0.00	
Angiola	115	50	81.6	0.00	
Auburn	110	51	77.6	0.00	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Azusa	100	51	72.7	0.00	
Bagdad	119	72	97.0	0.00	
Bakersfield	114	53	81.3	0.00	
Barber				0.00	
Barstow	110	58	82.1	0.00	
Bear Valley				0.00	
Berkeley	97	46	61.4	0.00	
Bishop	99	45	73.4	0.00	
Blue Canyon	94	36	65.4	0.00	
Bodie	93	18	57.2	0.00	
Branscomb	104	40	69.3	0.00	
Brush Creek	114	42	73.0	0.00	
Butte Valley				0.12	
Calabasas				0.00	
Calexico	117	64	88.6	0.03	
Campbell	105	42	65.4	0.00	
Campo				0.00	
Cedarville	107	45	74.9	T.	
Chico	114	55	80.1	0.00	
Claremont	103	49	72.7	0.00	
Cloverdale	115	45	73.2	0.00	
Colfax	101[e]	52[e]	77.6[e]	0.00	
Colusa	110	54	77.4	0.00	
Craftonville				0.00	
Crescent City	89	42	57.2	0.05	
Cuyamaca	89	45	66.4	0.00	
Delta	114	49	78.6	0.00	
Diamond				0.01	
Dobbins	113	53	81.0	0.00	
Durham	113	55	80.7	0.00	
Elcajon	102	52	72.0	0.03	
Electra	111	55	80.2	0.00	
Elmwood	116	48	78.0	0.00	
Elsinore	110	60	81.8	0.00	
Emigrant Gap	94	46	71.0	0.00	
Escondido	99	47	70.4	0.00	
Folsom	119	52	79.2	0.00	
Fordyce				T.	
Fort Ross	80	43	57.8	0.00	
Foster				0.08	
Fruitvale				T.	
Georgetown	105	50	75.3	0.00	
Gilroy (near)	112	42	67.6	0.00	
Greenville	101	35	76.5	T.	
Hanford	113	52	80.2	0.00	
Healdsburg	116	43	71.6	0.00	
Hollister	112	42	66.8	0.00	
Indio	125	67	92.8	0.00	
Idylwild	99	40	68.9	0.03	
Imperial	124	62	90.8	0.07	
Iowa Hill	104	52	75.1	0.00	
Irvine				0.00	
Isabella	109	57	82.8	0.00	
Kennedy Gold Mine				0.00	
Kentfield				0.00	
Kernville				0.00	
King City	116	42	71.2	0.00	
Le Grand	113[d]	56[d]	81.4[d]	0.00	
Lemoncove	112	53	82.6	0.00	
Lick Observatory	92	51	71.3	0.00	
Livermore	113	45	70.6	0.00	
Lodi	110	46	72.4	0.00	
Lone Pine	102	45	74.2	0.00	
Los Gatos	109	47	70.2	0.00	
Magalia	110	56	81.6	0.00	
Mammoth	124	70	95.0	0.00	
Marysville	118	51	77.0	0.00	
Merced	116	41	77.8	0.00	
Mills College				0.00	
Milo				0.00	
Milton (near)	110	53	78.6	0.00	
Mohave	114	68	95.8	0.00	
Mokelumne Hill	106	50	77.1	0.00	
Montague	107	50	75.7	0.12	
Monterio	102	60	78.6	0.00	
Monumental	101	39	68.4	0.00	
Mount St. Helena				0.00	
Napa	110	52	69.8	0.00	
Needles	114	71	93.5	0.06	
Nellie				0.00	
Nevada City	103	43	70.4	0.00	
Newcastle	112	54	80.8	0.00	
Newman	115	50	79.3	0.00	
Niles	105	46	67.8	0.00	
Nordhoff	103	43	68.2	0.00	
North Bloomfield	105	45	72.6	0.00	
Oakland	100	50	64.0	0.00	
Ontario (near)	99[b]	51[b]	73.0[b]	0.00	
Orland	120	45	81.7	0.00	
Orleans	117	50	81.0	0.00	
Oroville (near)	114	51	79.4	0.00	
Ozena				0.00	
Palermo	116	50	78.5	0.00	
Peachland	109	42	64.8	T.	
Pilot Creek				0.00	
Pine Crest	92	51	64.8	0.20	
Placerville	104	44	71.2	0.00	
Point Lobos	79	53	60.8	0.02	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Point Lomo	.....	.....	.....	0.15	
Point Reyes Light	91	47	54.9	0.00	
Porterville	114	49	80.9	0.00	
Poway	95	56	72.1	0.00	
Priest Valley	.....	.....	.....	0.00	
Quincy	97	37	67.3	0.00	
Redding	110	59	82.6	0.00	
Redlands	106	52	75.4	0.00	
Reedley	116	54	82.2	0.00	
Represa	.....	.....	.....	0.00	
Riovista	108	51	72.9	0.00	
Riverside	103	48	72.4	0.00	
Rocklin	114	51	76.4	0.00	
Sacramento	103	52	70.8	0.00	
Salton	120	66	91.0	0.00	
San Bernardino	108	49	75.2	0.00	
San Jacinto	109	50	71.1	0.00	
San Jose	106	46	68.7	0.00	
San Leandro	104	47	64.5	0.00	
San Rafael	98[i]	46[j]	68.5[j]	0.00	
Santa Barbara	85	54	65.6	0.18	
Santa Clara	111	40	67.8	0.05	
Santa Cruz	102	40	62.8	0.02	
Santa Maria	92	48	64.1	0.02	
Santa Rosa	109	42	65.8	0.00	
Shasta	119	51	85.0	0.00	
Sierra Madre	94	52	69.8	0.00	
Sisson	108	43	73.0	T.	
Sonoma	106	45	66.0	0.00	
Sonora	108	66	83.9	0.00	
Southeast Farallon	64	50	54.2	0.00	
Sterling	.....	.....	.....	0.00	
Stockton	110	50	73.6	0.00	
Storey	114	50	78.7	0.00	
Summerdale	92	46	68.4	0.00	
Summit	80	54	68.8	T.	
Susanville	98	42	68.8	0.08	
Tejon	104	58	81.4	0.00	
Towle	100	45	70.4	0.00	
Truckee	94	34	64.9	0.00	
Tulare	112	54	79.4	0.00	
Tustin	.....	.....	.....	T.	
Ukiah	111	45	73.0	0.00	
Upland	96	42	69.4	0.00	
Upperlake	109	43	73.4	0.00	
Upper Mattole	.....	.....	.....	0.00	
Vacaville	115	46	73.6	0.00	
Visalia	114	49	79.3	0.00	
Volcano	128	66	94.3	0.00	
Wasco	115	55	82.7	0.00	
Weldon	.....	.....	.....	0.00	
Wheatland	113	52	77.0	0.00	
Willets	113[e]	41[e]	69.4[e]	0.00	
Willow	112	55	79.8	0.00	
Woodside	104	45	67.6	0.00	
Yosemite	103	40	71.7	0.00	
Yreka	.....	.....	.....	0.48	
Zenia	99	37	67.0	0.00	
Colorado.					
Akron	.....	.....	.....	3.82	
Alford	88	36	62.2	2.51	
Antelope Springs	81	24	51.9	1.84	
Ashcroft	78	29	54.2	1.84	
Bennett	.....	.....	.....	4.17	
Blaine	102	45	77.6	0.85	
Boulder	90	48	68.0	1.86	
Breckenridge	78	30	53.6	1.21	
Buenavista	84	40	61.9	1.05	
Burlington	96	36	69.6	4.61	
Canon City	96	43	70.6	1.28	
Cheesman	89	42	64.3	2.16	
Cheyenne Wells	97	43	69.8	2.22	
Clearview	75	31	52.6	3.84	
Collbran	94	42	68.7	0.69	
Colorado Springs	88	41	65.2	2.39	
Conejos	86	37	62.0	0.72	
Cripplecreek	.....	.....	.....	3.75	
Delta	100	45	73.4	0.20	
Eagle	87	33	60.6	0.45	
Fort Collins	91	42	65.6	2.17	
Fowler	.....	.....	.....	1.35	
Fox	96	42	68.4	2.22	
Frances	84	34	59.8	3.02	
Fruita	100	43	73.2	0.07	
Garnett	86	31	58.6	1.03	
Gleneyre	90	29	64.6	2.37	
Glenwood Springs	92	33	64.6	0.90	
Grand Valley	96	42	69.6	0.28	
Greeley	94	45	69.3	1.81	
Grover	.....	.....	.....	3.70	
Gunnison	84	29	58.6	1.26	
Halls Gulch	67	27	46.8	2.73	
Hamps	90	40	65.0	4.72	
Hoehne	99	38	67.4	3.89	
Holly	97	40	74.6	1.51	
Holyoke	98[h]	40[d]	70.6[d]	4.96	
Idaho Springs	86	40	63.8	1.87	
Lake City	80	32	60.2	2.35	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Colorado—Cont'd.	°	°	°	*Ins.*	*Ins.*
Lake Moraine	70	29	51.0	6.65	
Lamar	101	48	75.6	3.17	
Laporte	.....	.....	.....	1.84	
Las Animas	103	47	74.4	1.76	
Lay	92	26	62.9	0.67	
Leroy	94	47	68.2	2.56	
Longs Peak	76	27	52.0	1.95	
Mancos	91	36	63.4	1.33	
Meeker	88	28	64.4	0.77	
Montrose	92[e]	40[e]	67.5[e]	0.56	
Moraine	80	31	57.2	1.41	
Pagoda	89	33	61.6	1.92	
Paonia	97	46	72.2	0.43	
Platte Canon	.....	.....	.....	1.73	
Rockyford	96	48	72.6	1.30	
Saguache	87	34	62.4	1.00	
Salida	87	34	62.4	0.87	
San Luis	83	33	58.6	3.00	
Santa Clara	85	38	60.9	3.74	
Sapinero	86	32	60.1	1.43	
Sheridan Lake	96	41	70.9	2.67	
Silt	93	39	68.7	0.45	
Silverton	78	28	53.7	3.21	
Sugar City	.....	.....	.....	2.50	
Sugar Loaf	81[d]	38[d]	60.8[d]	.....	
Trinidad	92	44	68.6	2.56	
Victor	80	35	57.8	3.78	
Vilas	.....	.....	.....	1.37	
Wagon Wheel	83	24	54.2	1.50	
Waterdale	91	40	65.8	1.51	
Westcliffe	85	32	60.4	1.82	
Whitepine	76	27	52.3	2.47	
Wray	98	43	70.8	2.98	
Yuma	.....	.....	.....	4.45	
Connecticut.					
Bridgeport	98	51	73.9	13.04	
Canton	92	42	69.6	4.22	
Colchester	93	49	71.2	2.26	
Falls Village	.....	.....	.....	4.79	
Hawleyville	94	49	71.7	5.12	
New London	91	56	72.4	2.76	
North Grosvenor Dale	93	45	72.0	0.76	
Norwalk	98	49	73.6	3.91	
Southington	94	48	72.0	2.95	
South Manchester	.....	.....	.....	2.13	
Storrs	91	51	71.1	1.77	
Voluntown	96	44	71.0	1.58	
Wallingford	.....	.....	.....	2.25	
Waterbury	97	47	73.0	4.20	
West Cornwall	92	50	71.5	5.83	
West Simsbury	.....	.....	.....	3.13	
Delaware.					
Delaware City	.....	.....	.....	4.93	
Milford	101	57	77.2	6.08	
Millsboro	99	56	77.0	5.63	
Newark	96	57	75.0	2.86	
Seaford	95	57	74.4	6.73	
District of Columbia.					
Distributing Reservoir[e,5]	94	65	77.7	9.63	
Receiving Reservoir[e,5]	90	65	77.5	8.60	
West Washington	102	62	79.7	11.56	
Florida.					
Apalachicola	94	73	82.6	11.23	
Archer	98	66	81.7	4.93	
Avon Park	96	68	82.0	13.70	
Bartow	97	68	83.1	10.79	
Bonifay	95	67	81.3	4.53	
Brooksville	95	68	81.0	10.16	
Carrabelle	96	71	83.4	4.24	
Caxambas	95	71	82.8	5.20	
Clermont	99	69	83.4	5.03	
De Funiak	97	61	80.2	5.82	
Eustis	98	68	82.6	2.62	
Federal Point	97	69	81.7	4.81	
Fernandina	96	71	82.6	5.11	
Fort Meade	96	68	81.6	13.75	
Fort Myers	93	70	81.0	13.90	
Fort Pierce	93	68	81.0	5.51	
Gainesville	95	69	81.2	8.30	
Grasmere	97	71	83.4	.....	
Huntington	100	68	82.5	3.41	
Hypoluxo	93	69	80.6	10.46	
Inverness	93	68	80.2	19.67	
Jasper	96	67	82.0	2.30	
Johnstown	96	66	81.1	8.70	
Kissimmee	94[e]	65	81.0[f]	14.05	
Lake City	98	69	82.3	4.29	
Macclenny	97	67	81.6	3.24	
Madison	93	71	81.0	8.05	
Malabar	95	69	82.2	8.36	
Manatee	93	63	80.4	9.46	
Marianna	98[f]	66	82.4[e]	4.45	
Merritt Island	92	71	81.2	9.82	
Miami	92	69	81.7	3.63	
Middleburg	100	64	81.2	8.35	
Molino	99	61	79.8	5.94	
Monticello	94	68	80.9	6.25	
Mount Pleasant	96	68	80.0	6.40	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Florida—Cont'd.	°	°	°	*Ins.*	*Ins.*
New Smyrna	98	67	81.4	7.04	
Nocatee	96	63	81.8	16.39	
Ocala	98	68	81.6	6.79	
Orange City	102	68	84.0	5.16	
Orange Home	97	69	81.8	7.37	
Orlando	99	69	81.8	6.15	
Rockwell	96[b]	70[b]	81.8[b]	.....	
St. Andrews	95	69	82.2	5.75	
St. Augustine	96	69	82.0	3.08	
St. Leo	95	67	81.0	9.48	
Sand Key	94	68	83.1	2.25	
Stephensville	97[a]	68[a]	81.2[a]	12.28	
Sumner	93	67	79.8	8.38	
Switzerland	95	68	81.0	7.04	
Tallahassee	93	68	80.0	8.76	
Tarpon Springs	94	68	80.2	10.88	
Titusville	99[d]	62[d]	81.6[d]	11.90	
Wausau	.....	.....	.....	5.13	
Georgia.					
Abbeville	.....	.....	.....	3.91	
Adairsville	91	61	77.8	4.34	
Albany	100	70	84.0	1.72	
Allapaha	97	67	82.0	5.00	
Americus	97	67	82.1	2.28	
Athens	96	58	78.6	5.61	
Bainbridge	101	65	84.0	4.38	
Blakely	97	67	81.4	4.32	
Bowersville	96	61	78.9	5.48	
Butler	.....	.....	.....	3.21	
Camak	97	64	79.4	4.54	
Canton	.....	.....	.....	7.01	
Carlton	.....	.....	.....	5.34	
Carrollton	92	64	76.8	9.84	
Clayton	91	58	74.2	13.13	
Columbus	97	68	82.4	1.98	
Cordele	97	66	81.2	3.07	
Covington	99	60	80.6	5.09	
Dahlonega	93	54	75.6	6.78	
Dawson	99	65	83.2	2.39	
Diamond	89	73	74.1	2.50	
Dudley	98	67	82.4	2.46	
Eastman	100	64	84.1	3.79	
Eatonton	97	64	80.8	4.93	
Elberton	97	64	79.9	6.10	
Experiment	94	65	79.7	3.01	
Fitzgerald	99	64	82.7	3.52	
Fleming	99	66	81.6	11.06	
Forsyth	97	64	80.0	6.28	
Fort Gaines	94	69	81.0	4.67	
Gainesville	95	56	77.0	4.29	
Gillsville	93	60	78.0	3.33	
Glenville	102	67	82.6	5.13	
Greenbush	93	60	77.3	3.17	
Greensboro	98	63	81.2	3.00	
Griffin	95	65	79.7	3.50	
Harrison	96	65	80.3	3.45	
Hawkinsville	104	65	84.0	0.66	
Lost Mountain	94	59	77.6	7.10	
Louisville	100	66	82.2	4.33	
Lumpkin	95	65	80.2	1.96	
Marshallville	98	69	82.5	4.08	
Mauzy	94[e]	68[e]	80.7[e]	7.64	
Milledgeville	98	67	82.2	5.45	
Millen	99	67	82.7	5.60	
Montezuma	.....	.....	.....	2.04	
Monticello	97	60	80.5	6.16	
Morgan	98	68	80.6	4.78	
Newnan	97	61	79.6	3.51	
Oakdale	.....	.....	.....	10.02	
Point Peter	98	62	79.8	3.13	
Poulan	95	67	81.0	3.77	
Putnam	98	65	82.3	2.91	
Quitman	98	69	82.0	4.14	
Ramsey	91	55	76.5	5.86	
Resaca	.....	.....	.....	3.99	
Rome	94	60	78.3	4.54	
St. Marys	102	69	83.8	4.16	
Screven	95	.....	.....	10.30	
Statesboro[c]	99	62	81.6	.....	
Talbotton	100	63	80.6	2.98	
Tallapoosa	95	57	76.9	4.46	
Thomasville	96	69	81.6	3.85	
Toccoa	89	59	75.0	10.40	
Valdosta	94	67	81.1	2.70	
Valona	96	67	80.9	8.20	
Vidalia	96	65	82.6	7.89	
Washington	94	66	79.2	4.34	
Waverly	99	69	82.6	5.96	
Waycross	101	69	82.6	4.17	
Waynesboro	99	67	80.4	7.06	
Westpoint	102	67	82.6	1.56	
Woodbury	98	60	79.4	3.01	
Idaho.					
Albion	96[d]	38[d]	68.8[d]	0.32	
American Falls	99	39	71.2	0.30	
Blackfoot	99	37	69.2	0.16	
Blue Lakes	103	51	75.7	0.54	
Burnside	98	45	70.4	0.75	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Idaho—Cont'd.	°	°	°	*Ins.*	*Ins.*
Caldwell	104	43	74.2	T.	
Cambridge	108	44	73.7	0.00	
Chesterfield	95	30	64.2	0.19	
Collins	.....	.....	.....	0.04	
Dewey	93[e]	37[e]	66.2[e]	T.	
Ellerslie	97	41	72.4	0.06	
Fernwood	102	47	74.4	0.16	
Forney	93	32	60.9	0.66	
Franklin	.....	.....	.....	0.14	
Garnet	109	55	81.5	0.00	
Grangeville	98	40	67.6	0.56	
Hope	.....	.....	.....	1.30	
Idaho City	94	37	64.8	T.	
Idaho Falls	94	39	67.4	1.12	
Kellogg	100	37	65.6	0.57	
Lakeview	98	42	67.0	0.90	
Landore	91	34	61.7	0.50	
Lardo	.....	.....	.....	0.07	
Lemhi Agency	94[k]	38[k]	64.0[k]	0.20	
Lost River	91[d]	42[e]	67.0[e]	0.39	
Lovell	107	33	67.0	0.02	
Malad	93	30	64.2	0.00	
Meadows	102	35	65.6	0.37	
Milner	101	43	73.4	0.00	
Minidoka	102	41	73.6	0.35	
Mink Creek	96	46	69.9	0.02	
Moscow	103	43	69.8	0.10	
Murray	98	32	61.6	0.91	
Oakley	96	42	69.8	0.80	
Ola	106	43	73.5	T.	
Paris	85	35	60.5	0.34	
Payette	111	48	77.1	0.00	
Pearl	.....	.....	.....	0.00	
Poplar	.....	.....	.....	T.	
Porthill	92	40	67.4	0.89	
Priest River	98	50	73.4	0.76	
St. Maries	102	40	68.4	0.15	
Salem	.....	.....	.....	0.26	
Soldier	98	30	65.0	T.	
Standrod	.....	.....	.....	0.69	
Vernon	93	35	65.6	0.07	
Westlake	.....	.....	.....	1.07	
Weston	98	37[d]	69.5[f]	0.47	
Illinois.					
Aledo	92	52	70.9	2.46	
Alexander	93	51	73.8	4.33	
Antioch	94	48	69.2	5.80	
Ashton	93	49	69.6	2.02	
Astoria	92	48	71.8	2.51	
Aurora	94	48	70.5	2.72	
Beardstown	.....	.....	.....	5.78	
Benton	95	56	75.8	8.65	
Bloomington	97	50	74.6	4.06	
Bushnell	95	53	73.7	3.03	
Cambridge	95	54	72.4	2.11	
Carlinville	95	54	74.2	7.44	
Carlyle	.....	.....	.....	11.21	
Carrollton	96	53	74.2	8.05	
Charleston	94	53	74.6	7.19	
Chester	99	58	77.7	13.56	
Cisne	96	55	75.4	5.06	
Coatsburg	95	53	73.5	4.09	
Cobden	95	54	75.8	9.55	
Colchester	95	53	73.0	2.33	
Decatur	95	52	74.2	3.82	
Dixon	96[f]	51[f]	70.0[f]	1.97	
Effingham	92	54	72.9	3.89	
Equality	97	57	77.2	9.40	
Flora	95[b]	54[d]	74.0[e]	5.85	
Friendgrove	92	56	74.4	7.61	
Galva	94	52	71.5	2.16	
Grafton	.....	.....	.....	5.09	
Greenville	95	55	74.4	4.46	
Griggsville	96	57	75.2	2.95	
Halfway	.....	.....	.....	5.00	
Havana	97	54	74.8	2.58	
Henry	93	50	72.0	2.51	
Hillsboro	96	55	75.5	5.32	
Hoopeston	94	51	73.6	3.81	
Joliet	94	53	72.6	4.18	
Kishwaukee	94	50	70.6	2.65	
Knoxville	92	50	70.8	4.59	
Lagrange	99	52	72.8	3.56	
Laharpe	96	50	72.0	2.40	
Lanark	93	45	69.8	4.01	
Loami	.....	.....	.....	3.15	
McLeansboro	97	58	75.8	7.39	
Martinsville	92[e]	52[e]	73.2[e]	5.64	
Martinton	97	51	73.4	2.68	
Mascoutah	92	55	73.2	6.07	
Mattoon	93	58	76.2	5.74	
Minonk	95	49	72.8	2.07	
Monmouth	97	51	72.0	2.89	
Morrison	95	47	70.0	2.52	
Morrisonville	93	53[k]	72.4[f]	5.10	
Mount Carmel	.....	.....	.....	7.48	
Mount Pulaski	93	55	74.2	3.64	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Illinois—Cont'd.	°	°	°	*Ins.*	*Ins.*
Mount Vernon	97	54	75.4	7.97	
New Burnside	96	54	75.8	10.39	
Olney	96	54	74.9	4.13	
Ottawa	94	51	71.4	1.68	
Palestine	95	54	75.0	6.28	
Pana	95	59	74.8	6.88	
Paris	94	55	74.0	5.31	
Philo	93	48	72.8	6.00	
Plumhill	90	54	73.4	9.46	
Pontiac	92	54	74.0	1.78	
Rantoul	94	50	73.2	4.73	
Raum	94	56	75.4	6.17	
Riley	92	49	69.7	3.30	
Robinson	92	53	73.8	6.20	
Rushville	92	52	72.6	2.83	
St. Charles	96	49	71.3	2.70	
St. John	96	56	75.2	13.49	
Shobonier	93[e]	54[e]	77.0[e]	9.72	
Streator	95	50	71.6	4.10	
Sullivan	93	51	73.4	6.37	
Sycamore	97	50	71.4	3.20	
Tilden	92	56	74.0	11.34	
Tiskilwa	90	53	70.5	1.82	
Tuscola	93	51	73.0	6.01	
Urbana	92	52	72.9	5.40	
Walnut	95	50	72.2	2.19	
Warsaw	.....	.....	.....	3.80	
Winchester	93	52	73.4	2.81	
Windsor	93	51	72.6	8.06	
Winnebago	94	49	70.2	3.67	
Yorkville	97	49	72.9	3.90	
Zion	93	49	69.8	1.63	
Indiana.					
Anderson	90	50	72.6	3.39	
Angola	92	50	71.6	4.13	
Auburn	93	47	71.9	3.11	
Bedford	92	54	74.5	3.60	
Bloomington	94	54	74.8	4.27	
Butlerville	94	57	74.9	4.60	
Cambridge City	92[b]	50[l]	73.1[l]	.....	
Columbus	94	50	73.4	2.28	
Connersville	96	49	74.4	5.18	
Crawfordsville	94	59	74.2	5.07	
Delphi	95	49	73.2	5.16	
Elkhart	95	52	73.0	4.84	
Farmersburg	94[b]	51[e]	75.4[e]	4.77	
Farmland	92	48	73.6	3.11	
Fort Wayne[k]	92	58	74.8	.....	
Franklin	95	51	74.2	4.92	
Greencastle	90	54	72.4	4.33	
Greenfield	93	50	74.0	1.88	
Greensburg	95	52	74.2	2.51	
Hammond	94	51	70.4	3.93	
Hector	.....	49	.....	3.20	
Holland	97	55	76.5	9.83	
Huntington	94	49	71.6	2.25	
Jeffersonville	95	58	77.4	4.37	
Kokomo	94	45	73.1	1.45	
Lafayette	93	50	73.7	5.46	
Laporte	90	54	70.4	4.01	
Logansport	96	48	73.6	1.97	
Madison	97	55	77.6	3.35	
Marengo	94	53	74.8	7.80	
Marion	95	48	73.2	3.89	
Markle	94	48	71.7	3.10	
Mauzy	93	47	73.0	4.20	
Moores Hill	94	51	74.4	2.78	
Mount Vernon	95	55	75.5	10.64	
Northfield	92	44	71.4	2.49	
Paoli	94	54	74.4	5.66	
Princeton	95	54	75.2	9.68	
Rensselaer	94	49	72.2	3.80	
Richmond	94	47	72.8	3.90	
Rochester	92	49	72.4	4.57	
Rockville	93	53	72.7	6.64	
Rome	100	54	76.5	5.59	
Salem	97	52	75.4	5.33	
Scottsburg	95	55	77.4	4.52	
Seymour	93	53	74.6	3.82	
Shelbyville	95	50	74.6	4.02	
South Bend	92	53	71.8	5.47	
Syracuse	94	48	73.2	4.25	
Terre Haute	94	56	76.0	6.68	
Valparaiso	93	51	72.8	4.85	
Veedersburg	.....	.....	.....	4.52	
Vevay	96	55	76.4	6.75	
Vincennes	97	55	76.4	8.96	
Washington	95	55	74.8	5.75	
Winamac	94	49	72.6	.....	
Worthington	94	53	74.9	4.70	
Indian Territory.					
Ardmore	98	55	79.1	3.34	
Calvin	.....	.....	.....	5.36	
Chickasha	107[e]	53[e]	82.6[e]	4.25	
Durant	96	57	77.0	8.07	
Fairland	94	59	75.0	6.26	
Fort Gibson	.....	.....	.....	6.57	
Goodwater	96[e]	58[e]	79.4[e]	9.24	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Indian Territory—Cont'd.	°	°	°	*Ins.*	*Ins.*
Hartshorne	96	56	77.4	11.69	
Healdton	98	51	77.6	3.43	
Holdenville	96	56	77.4	8.60	
Marlow	97	53	77.6	3.66	
Muskogee	93	53	76.1	7.85	
Okmulgee	94	55	76.9	11.26	
Pauls Valley	96	51	77.1	6.90	
Ravia	99	56	78.4	5.35	
Roff	96	55	79.8	4.36	
South McAlester	95	67[b]	80.2[e]	9.34	
Tahlequah	.....	.....	.....	11.50	
Tulsa	96	59	76.8	5.96	
Vinita	94	57	76.2	4.02	
Wagoner	93	58	76.8	11.19	
Webbers Falls	96	56	77.4	8.62	
Iowa.					
Afton	98	50	71.6	2.84	
Albia	94	53	70.6	7.08	
Algona	95	48	69.4	1.18	
Allerton	94	49	71.2	3.62	
Alta	95	49	68.9	1.47	
Alton	95	48	69.5	1.55	
Altoona	.....	.....	.....	2.47	
Amana	93	52	71.0	2.65	
Ames	93	49	70.4	2.14	
Atlantic	97	42	70.2	2.34	
Audubon	96	45	69.5	2.83	
Baxter	95	50	70.2	4.54	
Bedford	95	47	71.4	2.87	
Belleplaine	95	52	70.8	5.93	
Bonaparte	93	50	72.0	2.54	
Boone	95	51	70.6	3.52	
Britt	94	46	69.6	1.97	
Buckingham	.....	.....	.....	5.17	
Burlington	94	53	72.8	3.30	
Carroll	96	46	69.4	2.97	
Cedar Rapids	98	54	72.7	2.78	
Chariton	93	50	70.0	4.91	
Clarinda	101	49	72.3	5.22	
Clearlake	98	50	71.2	1.60	
Clinton	96	48	71.8	1.48	
College Springs	96	50	71.8	2.64	
Columbus Junction	93	53	71.0	2.75	
Corning	95	44	70.5	2.25	
Corydon	92	51	71.3	4.74	
Cresco	93	50	68.0	1.33	
Creston	94	48	69.8	3.42	
Cumberland	.....	.....	.....	4.02	
Decorah	98	48	69.8	3.32	
Delaware	92	47	69.0	1.75	
Desoto	92	52	70.1	4.73	
Dows	94	46	68.4	1.75	
Earlham	92	47	69.0	3.49	
Elkader	98	46	71.6	2.23	
Elliott	99	45	72.1	2.18	
Estherville	96	46	68.8	3.05	
Fayette	93	42	68.4	2.62	
Florence	.....	.....	.....	2.14	
Forest City	96	49	70.0	3.30	
Fort Dodge	97	49	70.4	2.06	
Fort Madison	.....	.....	.....	3.64	
Galva	94	43	68.4	2.60	
Glenwood	93	50	70.6	3.13	
Grand Meadow	92	50	69.0	3.19	
Greene	97	49	70.6	1.86	
Greenfield	100	47	71.6	2.81	
Grinnell	93	49	70.3	5.96	
Grundy Center	94	49	69.6	4.46	
Guthrie Center	96	49	71.0	3.53	
Hampton	97	50	70.8	3.06	
Hancock	97	49	71.4	2.68	
Hanlontown	94	47	67.6	3.04	
Harlan	95	45	69.8	4.21	
Humboldt	96	48	68.9	1.24	
Ida Grove	97[e]	41[e]	71.6[e]	1.65	
Independence	96	47	69.2	2.41	
Indianola	95	52	70.6	3.17	
Inwood	100	45	68.7	1.29	
Iowa City	95	52	71.6	3.59	
Iowa Falls	94	47	69.3	2.79	
Jefferson	97	51	73.1	2.16	
Keosauqua	96	50	72.3	2.57	
Lacona	.....	.....	.....	4.22	
Larrabee	99[e]	44[e]	72.0[e]	0.63	
Leclaire	.....	.....	.....	2.30	
Lemars	97	45	70.1	2.86	
Lenox	95	51	71.0	1.81	
Leon	93	52	71.6	2.76	
Little Sioux	97	47	71.8	1.15	
Logan	97	46	72.1	4.29	
Maple Valley	.....	.....	.....	1.93	
Maquoketa	94	44	70.0	4.46	
Marshalltown	97	49	70.2	4.60	
Mason City	98	52	70.6	2.25	
Massena	100	48	72.2	1.91	
Monticello	98	45	71.0	2.24	
Montezuma	.....	.....	.....	3.62	
Mountayr	96	51	71.6	3.61	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Mount Pleasant	97	52	72.4	2.91	
Mount Vernon	95	51	71.4	1.43	
Muscatine	.....	.....	.....	4.59	
Nevada	.....	.....	.....	3.71	
New Hampton	96	51	70.3	2.82	
Newton	94	53	69.8	6.12	
Northwood	94	49	69.3	1.92	
Odebolt	99	46	70.9	2.58	
Ogden	95	48	70.3	2.91	
Olin	92[3]	.....	71.5[4]	3.12	
Onawa	98	50	73.1	1.14	
Osage	96	49	69.3	1.49	
Oskaloosa	93	51	71.0	3.62	
Ottumwa	96	48	72.4	2.40	
Pacific Junction	96	47	70.8	4.17	
Perry	95	50	71.2	4.05	
Plover	95	43	69.3	1.18	
Pocahontas	97	47	70.2	1.83	
Redoak	96	49	73.1	3.21	
Ridgeway	96	52	71.6	1.85	
Rock Rapids	96	46	70.1	2.63	
Rockwell City	95	48	69.4	2.99	
Sac City	93	50	69.1	3.65	
St. Charles	93	52	70.4	6.63	
Sheldon	100	42	70.1	1.20	
Sibley	95	46	67.4	2.40	
Sidney	96	51	73.1	3.72	
Sigourney	95	51	72.6	4.35	
Sioux Center	96	47	69.4	0.73	
Stockport	90	55	71.1	1.88	
Storm Lake	95	47	68.0	1.30	
Thurman	95	50	72.2	6.30	
Tipton	96	55	73.2	2.55	
Toledo	93	50	69.4	5.30	
Vinton	93	49	69.9	2.44	
Washington	92[2]	52[2]	70.6[2]	3.39	
Washta	98	40	69.0	0.69	
Waterloo	98	51	71.0	4.35	
Waukee	102	50	72.6	3.53	
Waverly	92	51	69.2	2.84	
Webster City	99	47	71.5	3.03	
Westbend	94	47	69.0	1.58	
Whitten	96	48	70.4	5.23	
Wilton Junction	96	48	71.9	3.26	
Winterset	95	50	70.5	3.65	
Woodburn	92	48	70.6	5.60	
Zearing	96	51	70.0	2.09	
Kansas.					
Abilene	.....	.....	.....	3.69	
Achilles	105	40	74.0	4.31	
Alton	100	47	74.0	4.72	
Anthony	.....	.....	.....	3.48	
Atchison	95	51	73.0	5.61	
Baker	95	48	72.5	5.33	
Beloit	.....	.....	.....	7.79	
Blue Rapids	.....	.....	.....	4.81	
Burlington	97	51	75.1	7.17	
Chapman	96	52	75.0	6.24	
Clay Center	98	49	74.2	3.59	
Colby	100	38	70.8	2.06	
Columbus	94	58	74.7	10.82	
Cottonwood Falls	96	51	75.6	4.98	
Cunningham	100	50	77.6	10.45	
Dresden	99	45	71.8	8.46	
Eldorado	93	51	75.4	10.62	
Ellinwood	99	51	74.7	6.90	
Ellsworth	100	48	74.8	2.05	
Emporia	93	53	73.4	5.04	
Englewood	100	48	79.7	8.37	
Enterprise	95	53	73.5	3.80	
Eureka	.....	.....	.....	5.55	
Fall River	96	53	75.5	4.68	
Farnsworth	98	45	72.4	5.51	
Forsha	97	49	76.1	6.12	
Fort Leavenworth	96	56	74.6	5.70	
Fort Scott	97	55	74.8	11.45	
Frankfort	99	46	73.2	4.55	
Garden City	100	44	74.8	0.86	
Gove[1]	96	50	69.7	5.51	
Grenola	95	52	74.3	3.73	
Harrison	99	45	72.1	6.73	
Horton	95	52	72.6	5.15	
Hoxie	97	44	72.8	7.50	
Hugoton	99	48	75.0	2.56	
Hutchinson	99	49	75.0	6.74	
Independence	103	58	78.4	2.26	
Ioia	.....	.....	.....	4.82	
La Crosse	103	47	74.6	5.32	
Lakin	101	42	74.3	1.19	
Larned	101	44	73.9	5.90	
Lebo	96	54	75.1	6.74	
Lindsborg	.....	.....	.....	3.11	
Macksville	101	46	74.8	6.90	
McPherson	98	49	75.2	4.37	
Madison	96	52	75.0	5.75	
Manhattan[b]	100	51	76.0	4.95	
Manhattan[c]	99	49	74.4	4.96	
Marion	98	53	74.4	6.00	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Kansas—Cont'd.	°	°	°	*Ins.*	*Ins.*
Medicine Lodge	108	50	80.6	4.55	
Minneapolis	96	49	73.4	4.51	
Moran	96	57	75.4	5.11	
Mounthope	95	54	76.6	4.58	
Neosho Rapids	.....	.....	.....	6.78	
Ness City	103	47	75.8	7.44	
Newton	98	50	75.4	3.60	
Norwich	97	51	76.0	5.55	
Oberlin	.....	.....	.....	6.67	
Osage City	96	52	73.8	7.09	
Osborne	.....	.....	.....	4.72	
Oswego	91	57	74.8	6.78	
Ottawa	95	49	73.6	9.17	
Plainville	98	46	72.6	5.46	
Pleasanton	93	55	74.4	7.77	
Pratt	103	51	77.1	7.62	
Republic	99	47	73.1	10.21	
Rome	101	53	78.2	4.17	
Russell	93	47	74.0	3.04	
Salina	97	48	74.5	3.83	
Sedan	99	57	76.8	2.67	
Toronto	101	51	75.4	4.33	
Ulysses	103	45	73.8	1.72	
Valley Falls	93	51	71.5	5.95	
Viroqua	97	45	73.4	1.61	
Wakeeney	98	43	72.8	6.65	
Wakeeney (near)	.....	.....	.....	6.76	
Wallace	97	42	70.8	3.22	
Walnut	94	57	76.4	8.49	
Wamego[a1]	94	56	73.6	5.34	
Winfield	96	51	76.4	4.32	
Yates Center	.....	.....	.....	4.69	
Kentucky.					
Alpha	90	55	74.8	10.48	
Anchorage	94	53	75.2	7.04	
Bardstown	97	54	77.0	8.99	
Beattyville	94	55	75.8	4.26	
Beaver Dam	96	52	77.1	4.30	
Berea	93	53	75.2	4.01	
Blandville	92	59	75.2	8.33	
Bowling Green	96	57	77.4	3.65	
Burnside	93	54	74.0	5.12	
Cadiz	94	56	76.7	4.45	
Calhoun	99	56	77.2	8.18	
Catlettsburg	94	55	76.0	3.24	
Earlington	96	55	76.4	6.59	
Edmonton	94	55	75.4	6.53	
Eubank	92	52	73.8	4.98	
Falmouth	.....	.....	.....	4.72	
Frankfort	92	56	75.6	3.91	
Franklin	91	63	77.4	2.01	
Greensburg	97	55	76.2	6.03	
High Bridge	99	56	76.8	8.28	
Hopkinsville	94	55	76.0	5.49	
Irvington	97	56	76.4	5.67	
Jackson	100	58	75.7	6.72	
Leitchfield	91	56	74.6	5.32	
Loretto	95	53	76.2	6.18	
Marion	92	59	75.3	6.18	
Mayfield	92	58	76.0	3.61	
Maysville	98	54	76.8	4.22	
Middlesboro	94	57	75.2	7.03	
Mount Sterling	94	54	76.2	6.12	
Owensboro	93	59	76.2	7.85	
Owenton	98	54	75.8	3.58	
Paducah	102	61	79.0	6.19	
Richmond	93	55	76.2	4.27	
St. John	91	55	74.0	5.93	
Scott	95	54	75.7	1.40	
Shelby City	91	52	74.4	5.82	
Shelbyville	97	53	76.0	5.76	
Taylorsville	95	55	74.6	6.34	
West Liberty	93	54	75.2	6.88	
Williamsburg	91	58	75.5	5.08	
Williamstown	91	55	73.6	4.06	
Louisiana.					
Abbeville	97	62	80.8	8.67	
Alexandria	101	62	81.0	9.71	
Amite	96	59	79.8	9.03	
Baton Rouge	97	61	80.9	6.07	
Burnside	96	62	79.8	5.35	
Calhoun	97[c]	60[d]	78.2[e]	6.93	
Cameron	92	64	81.8	8.96	
Caspania	97	62	79.4	13.41	
Cheneyville	97	61	81.2	9.14	
Clinton	92	61	78.2	12.77	
Collinston	97	63	81.2	7.37	
Covington	98	63	80.2	14.57	
Donaldsonville	100	63	81.4	8.65	
Farmerville	93[d]	65[d]	79.4[e]	9.26	
Franklin	96	64	81.3	11.50	
Georgetown	94	63	78.8	9.88	
Grand Cotesau	96	63	80.5	8.75	
Hammond	96	62	79.3	9.63	
Houma	95	63	80.4	8.62	
Jennings	95	64	80.0	6.74	
Lafayette	95	60	79.5	7.31	
Lake Charles	94	63	80.1	6.29	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Louisiana—Cont'd.	°	°	°	*Ins.*	*Ins.*
Lakeside	95	65	80.9	9.17	
Lawrence	97	67	81.8	7.66	
Libertyhill	97	60	79.4	10.00	
Logansport	.....	.....	.....	15.93	
Mansfield	95	59	78.3	11.14	
Melville	95	61	79.6	5.77	
Minden	97	61	80.1	11.27	
Monroe	99	62	80.1	5.20	
Morgan City	.....	.....	.....	10.89	
New Iberia	92	64	79.5	10.58	
Opelousas	96	62	80.3	5.71	
Plain Dealing	95	60	78.9	7.91	
Port Eads	91	72	82.0	7.05	
Rayne	95	63	80.9	13.29	
Reserve	106	70	83.0	5.95	
Robeline	95	60	73.2	10.86	
Ruston	97	60	79.4	10.35	
Schriever	100	60	80.8	8.19	
Simmesport	.....	.....	.....	9.60	
Sugar Experiment Station	95	65	81.1	4.02	
Sugartown	94	63	80.0	7.38	
Maine.					
Bar Harbor	89	45	65.0	3.35	
Chesuncook	90	46	67.6	1.52	
Cornish	91	45	69.4	9.11	
Danforth	.....	.....	.....	3.48	
Debsconeag	91	46	68.2	4.80	
Fairfield	91	47	69.8	3.65	
Farmington	92	43	68.5	4.07	
Gardiner	93	45	69.4	4.52	
Grant Farm	.....	.....	.....	2.70	
Greenville	.....	.....	.....	2.52	
Houlton	88	42	68.0	1.45	
Lewiston	92	50	70.1	4.58	
Madison	90	45	68.8	5.75	
Mayfield	84	48	66.6	4.39	
Millinocket	92	42	68.9	2.92	
North Bridgton	92	47	69.1	5.97	
Oquossoc	87	40	63.8	3.78	
Orono	90	42	68.6	2.19	
Patten	91	41	67.2	2.00	
Rumford Falls	91	46	68.8	4.61	
The Forks	.....	.....	.....	3.37	
Thomaston	87	45	66.5	4.93	
Vanburen	95	38	67.1	2.54	
Winslow	90	43	69.4	4.26	
Maryland.					
Annapolis	96	58	75.9	9.99	
Bachmans Valley	94	52	72.9	14.70	
Boettcherville	98	50	75.8	4.46	
Cambridge	98	62	78.9	5.96	
Cheltenham	94	59	75.8	6.89	
Chestertown	93	58	75.5	10.00	
Chewsville	95	51	73.6	6.54	
Clearspring	97	55	73.7	6.56	
Coleman	96	60	76.4	7.63	
Collegepark	101	53	76.6	6.97	
Colora	.....	.....	.....	6.13	
Cumberland	.....	.....	.....	5.20	
Darlington	96	54	73.6	6.46	
Deerpark	.....	.....	.....	5.27	
Denton	97	55	76.4	8.37	
Easton	93	60	75.6	6.12	
Fallston	95	57	74.0	6.19	
Frederick	95	55	75.6	8.05	
Grantsville	92	47	68.6	4.20	
Greatfalls	98	56	76.6	10.21	
Greenspring Furnace	94	52	74.1	6.83	
Hancock	97	51	75.2	6.90	
Harney	.....	.....	.....	7.66	
Jewell	93	61	75.6	7.82	
Johns Hopkins Hospital	98	60	77.6	10.93	
Keedysville	97	53	76.2	7.86	
Laurel	96	60	77.2	7.28	
McDonogh	.....	.....	.....	10.69	
Mount St. Marys College	.....	.....	.....	4.28	
New Market	92	55	74.3	7.18	
Oakland	87	44	67.8	7.61	
Pocomoke City	94	62	77.9	4.40	
Porto Bello	97	61	79.0	6.14	
Princess Anne	91	58	75.8	5.87	
Solomons	96	64	77.8	7.71	
Sudlersville	98	52	77.6	7.84	
Takoma Park	95	58	76.0	9.59	
Van Bibber	94	60	75.4	6.39	
Westernport	95	50	73.2	8.08	
Massachusetts.					
Amherst	93	46	71.8	2.63	
Bedford	89	51	70.6	1.81	
Bluehill (summit)	91	54	70.5	2.33	
Cambridge	94	52	73.5	1.07	
Chestnuthill	96	50	73.2	1.94	
East Templeton[f1]	92	54	72.8	3.32	
Fall River	91	57	72.0	2.61	
Fitchburg	92	51	71.6	4.62	
Framingham	93	50	70.8	5.21	
Groton	92	46	70.8	2.51	
Hyannis	.....	.....	.....	1.94	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Massachusetts—Cont'd.	°	°	°	*Ins.*	*Ins.*
Jefferson				3.83	
Lawrence	94	51	72.4	1.27	
Leominster				5.31	
Lowell	92	52	74.0	0.59	
Ludlow Center	88	41	67.3	2.56	
Middleboro	92	48	70.7	5.33	
Monson	91	47	70.8	1.88	
New Bedford	89	57	71.1	2.29	
Plymouth [e]	91	60	70.9	2.07	
Princeton				6.18	
Provincetown	90	58	70.8	1.79	
Salem				0.39	
Somerset [e]	98	54	74.4	4.05	
Sterling				5.49	
Taunton	92	48	70.8	2.65	
Webster				0.95	
Westboro	94	46	72.4	3.79	
Weston	91	47	70.5	2.02	
Williamstown	87	47	69.6	5.35	
Winchendon				3.63	
Worcester	93	54	72.8	2.44	
Michigan.					
Adrian	94	47	71.0	2.93	
Agricultural College	92	48	69.8	5.75	
Alma	93	45	69.0	4.79	
Ann Arbor	93	49	71.1	4.70	
Arbela	93	47	70.2	3.56	
Ball Mountain	90	49	68.5	5.78	
Battle Creek	93	50	71.9	5.71	
Bay City	93	48	70.0	5.65	
Benzonia	88[m]	47[l]	67.3[m]	3.19	
Berlin	93	46	69.1	3.61	
Big Rapids	90	43	67.2	5.36	
Birmingham	91	51	69.6	5.67	
Bloomingdale	94	48	71.2	4.16	
Calumet	82	41	63.3	2.93	
Cassopolis	92	60	74.6	5.30	
Charlevoix	91[f]	44	66.0[e]		
Charlotte	94	46	71.2	5.33	
Chatham	90	52	62.2	3.17	
Cheboygan	91	40	67.6	2.73	
Clinton	92	47	71.0	3.50	
Coldwater	92	46	70.7	4.61	
Concord	90	48	69.5	5.94	
Deer Park	88	42	60.0	2.73	
Detour	87	47	64.4	5.13	
Dundee	92	48	71.7	3.45	
Eagle Harbor	78	42	58.4	2.77	
East Tawas	92[e]	46[e]	67.6[e]	7.01	
Fennville	91	48	69.6	3.92	
Fitchburg	92	44	70.0	4.82	
Flint	92	46	68.8	3.90	
Gladwin	94	41	68.8	3.30	
Grand Haven	87	50	67.3	3.78	
Grand Marais	80	43	57.6	2.77	
Grape	92	49	70.8	5.50	
Grayling	92	44	67.0	3.76	
Hagar	96	46	70.2	5.95	
Harbor Beach	91	50	68.2	3.18	
Harrison	92	47	69.4	6.62	
Harrisville	90	49	66.5	4.26	
Hart	94	47	67.5		
Hastings	93	46	70.1	7.24	
Hayes	91	47	67.0	4.86	
Highland				4.34	
Hillsdale	93	46	71.0	3.29	
Holland	90	47	68.2	3.30	
Howell	90	48	69.8	4.33	
Humboldt	85	29	58.2	0.56	
Iron Mountain	95	45	64.6	4.71	
Iron River	91	36	63.7	5.20	
Ironwood	87	46	65.0	3.61	
Ishpeming	86[f]	36[f]	62.6[f]	2.38	
Ivan	93	43	68.0	4.33	
Jackson	97	50	72.6	4.25	
Jeddo	91	49	68.9	2.73	
Kalamazoo	92	50	70.2	4.38	
Lake City				3.50	
Lansing	92	49	70.4	4.18	
Ludington	82	47	68.8		
Mackinac Island	83	47	67.2	6.65	
Mackinaw City	88	48	67.8		
Mancelona	92	34	64.8	3.82	
Manistee	91	49	68.0		
Marine City	92	47[e]	68.8[e]	4.44	
Menominee	96	50	66.4	5.50	
Midland	95	40	67.6	3.65	
Montague	93	48	69.1	5.35	
Muskegon	91	49	69.4	6.56	
Newberry				1.70	
Old Mission	89	50	66.8	3.56	
Olivet	89	50	69.4	5.10	
Omer	92			3.11	
Onaway	81	43	64.6		
Ovid	90	46	69.7	4.61	
Owosso				4.15	
Petoskey	91	47	67.0		
Plymouth	93	41	68.0	5.30	
Michigan—Cont'd.					
Port Austin [c]	91	45	66.0		
Powers	95	42	66.2		
Reed City	93	36[d]	66.5[e]	7.25	
Saginaw (W. S.)	93	47	69.8	5.11	
St. Johns	94	47	70.2	6.50	
St. Joseph	87	56	69.9	3.65	
Slocum	90	45	68.8	6.31	
Somerset	89	46	69.2	5.52	
South Haven	89	46	67.0	3.42	
Stanton	90	41	68.4	4.03	
Thomaston	87	37	63.0		
Thornville	92	51	70.6	6.28	
Traverse City	90	49	66.3	7.46	
Vassar	94	47	70.1	2.48	
Wasepi	89	45	68.8	4.31	
Webberville				3.94	
Wetmore	90	24	60.1	2.30	
Whitefish Point	86	41	58.0	2.29	
Ypsilanti	90	48	69.0	3.97	
Minnesota.					
Albert Lea	98	50	70.0	1.98	
Alexandria	95	48	67.2	5.72	
Amboy	98	47	69.4	2.35	
Angus	88	38	64.5	3.58	
Ashby	90	45	65.6	7.38	
Beardsley	94	41	66.5	3.64	
Beaulieu	91	44	65.6	5.39	
Bemidji	94	44	67.4	5.91	
Bird Island	91	48	68.2	1.94	
Caledonia	93	48	68.2	0.69	
Collegeville	90[h]	48	68.8[d]	6.12	
Crookston	89	44	66.6	6.17	
Detroit	90	42	64.4	4.93	
Faribault	94	45	67.6	2.49	
Farmington	91	50	68.5	3.54	
Fergus Falls	92	47	67.9	4.32	
Glencoe	93	39	65.2	2.15	
Grand Meadow	94	47	67.8	3.10	
Hallock	84	40	65.2	3.03	
Halstad	91	41	66.0	5.63	
Hinckley	83	45	66.2	4.25	
Hovland	82	39	58.8	4.01	
Lake Winnibigoshish	90	50	68.2	7.65	
Leech	90	45	64.8	7.20	
Long Prairie	94	43	66.6	4.26	
Luverne	94	47	67.5	2.52	
Lynd	92	45	67.7	3.52	
Mankato				3.98	
Mapleplain	93	49	69.0	3.05	
Milaca				4.95	
Milan	90	42	66.4	5.82	
Montevideo	94	48	69.4	4.97	
Mora	91	41	66.0	3.41	
Morris	90	45	66.2	3.23	
Mount Iron	89	39	64.2	9.44	
New London	98	48	68.8	4.12	
New Richland	99	47	70.4	2.00	
New Ulm	97	51	71.4	5.97	
Park Rapids	91	46	65.4	4.94	
Peterson				1.98	
Pine River	92	38	63.0	5.47	
Pipestone	90	42	67.5	1.66	
Pokegama Falls	89	43	64.8	5.80	
Pratt	94	46	67.8	3.11	
Redwing	95	50	69.6	4.78	
Reeds				2.88	
St. Charles	95	48	69.1	3.50	
St. Cloud	93	48	69.1	5.41	
St. Peter	96	47	70.0	2.92	
Sandy Lake Dam	90	48	66.8	5.01	
Shakopee	92	49	69.4	2.57	
Tonka				3.21	
Wabasha	100	50	71.8	2.18	
Wadena	93	44	66.0	5.60	
Willow River	91	41	65.2	3.53	
Winnebago	98	47	70.1	3.79	
Winona	94	53	69.8	3.63	
Worthington	93	43	66.6	6.04	
Zumbrota	93	45	68.8	1.60	
Mississippi.					
Aberdeen	99	60	80.8	3.41	
Agricultural College	95	66	80.2	3.95	
Austin				3.52	
Batesville	94	60	78.8	1.95	
Bay St. Louis	96	65	80.8	3.93	
Biloxi	99	68	81.8	5.14	
Booneville	96	60	77.8	4.37	
Brookhaven	99	60	80.4	3.90	
Canton	95	61	79.1	3.28	
Columbus	97	61	79.6	4.58	
Corinth	91	60	76.8	2.71	
Crystal Springs	94	60	78.6	4.64	
Duck Hill	95	61	77.8	7.06	
Edwards	96	61	78.2	4.37	
Enterprise				2.20	
Fayette	94	60	77.7	5.72	
Fayette (near)				6.71	
Greenville *a*	96	64	80.4	5.47	
Mississippi—Cont'd.					
Greenville *b*	98	64	80.4	5.20	
Greenwood	97	63	79.1	4.92	
Hattiesburg				2.44	
Hazlehurst	95	61	78.5	4.80	
Hernando	94	62	77.4	2.70	
Holly Springs	93	64	78.8	1.50	
Indianola	93	66	79.9	4.07	
Jackson	96	62	79.4	3.38	
Kosciusko	99	61	78.5	3.49	
Lake	96	61	79.0	3.12	
Lake Como	100	60	80.2	4.67	
Laurel	99	60	79.9	6.04	
Leakesville	98	65	81.0	6.52	
Leland				4.14	
Louisville	93	62	78.2	2.46	
Macon	100	63	82.0	5.50	
McNeill	97	63	79.2	8.50	
Magnolia	102	58	81.0	7.91	
Merrill				4.52	
Natchez	95	66	80.7	3.92	
Nitta Yuma	97	62	80.6	5.68	
Okolona	100	66	82.8	2.00	
Patmos				5.28	
Pearlington	98	64	80.5	7.90	
Pecan	99	64	81.3	3.34	
Pittsboro	96	61	78.0	2.32	
Pontotoc	90	65	76.4	2.04	
Port Gibson	97	59	79.0	4.67	
Porterville	96	62	79.2	4.24	
Quitman	95	62	79.0	4.09	
Ripley	93[f]	59[f]	75.6[f]	5.88	
Shelby	100	61	79.6	4.15	
Shoccoe	96	62	79.5	4.06	
Shubuta				3.80	
Stonington				5.36	
Suffolk	96	59	78.2	9.17	
Swan Lake	97	61	79.9	6.21	
Tchula	100	62	78.0	6.70	
Tupelo	97	59	79.0	2.16	
University	93	62	78.2	2.69	
Utica	97	61	78.6	3.88	
Walnutgrove	92[e]	62[e]	77.8[e]	4.20	
Walthall				5.98	
Watervalley	96	63	78.2	3.33	
Waynesboro	98	63	79.2	4.29	
Woodville	95	62	79.8	10.58	
Yazoo City	96	61	79.4	3.80	
Missouri.					
Albany				5.30	
Appleton City	94	57	74.8	9.90	
Arlington				6.25	
Arthur	94	54	73.5	9.09	
Avalon	95	53	72.6	7.47	
Bagnell				5.75	
Bethany	92	49	70.2	6.45	
Birchtree	90[d]	59[d]	74.2[d]	11.96	
Blue Springs	93[d]	50[d]	73.0[d]	5.92	
Boonville				6.95	
Bourbon	94	54	73.3	8.59	
Brunswick	93	54	73.4	5.17	
Caruthersville	94	57	76.7	5.54	
Conception	94	52	72.3	4.40	
Darksville	95	52	73.0	3.54	
Dean	94	57	74.0	7.23	
De Soto	97	55	73.6	5.79	
Doniphan	92	57	74.7[e]	13.92	
Downing				4.81	
Eldorado Springs	91	55	73.4	10.81	
Fairport				4.29	
Fayette	90	50	71.0	4.60	
Fulton	93	48	73.1	3.81	
Gallatin [e]	92	60	73.4	6.13	
Gano	93	54	73.2	8.36	
Glasgow	92	54	73.4	6.72	
Goodland	90	51	71.8	10.32	
Gorin				3.38	
Grant City	97	53	71.9	5.10	
Harrisonville	98	55	74.0	6.52	
Hazlehurst				5.30	
Hermann				4.55	
Houston	91	52	72.3	14.39	
Huntsville	95	53	74.4	4.75	
Ironton	93	51	73.4	14.74	
Jackson	94	55	74.8	11.84	
Jefferson City	92	52	73.1	4.25	
Joplin	96	58	77.1	14.99	
Kidder	93	54	72.3	6.38	
Koshkonong	92	58	74.2	10.81	
Lamar	94	54	74.1	14.29	
Lamonte				6.99	
Lebanon	90	55	72.0	10.23	
Lexington	93	53	73.8	4.29	
Liberty	93	55	72.8	5.73	
Lockwood	89	57	72.1	17.98	
Louisiana	95	48	74.2	3.15	
Macon	95	54	73.8	4.43	
Marblehill	94	56	74.6	13.11	
Marshall	92	53	73.2	5.02	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Missouri—Cont'd.	°	°	°	*Ins.*	*Ins.*
Maryville	99	52	72.6	5.16	
Mexico	95	51	73.8	4.75	
Monroe	93	53	72.8	5.13	
Montreal	93	49	72.4	7.75	
Mountaingrove	88	56	71.8	14.93	
Mount Vernon	97	57	73.1	13.04	
Neosho	93	55	73.8	10.58	
New Haven	94	56	75.4	4.60	
New Madrid	.....	.....	.....	7.59	
New Palestine	93	54	74.0	5.06	
Oakfield	92	57	74.4	5.89	
Olden	91	53	73.8	13.18	
Oregon	92	53	72.3	3.70	
Osceola	.....	.....	.....	9.77	
Pine Hill	.....	.....	.....	11.60	
Princeton	101	54	75.0	2.35	
Protem	91	56	73.8	14.27	
Rockport	.....	.....	.....	2.55	
Rolla	.....	.....	.....	6.87	
St. Charles	95	55	74.4	3.19	
St. Joseph	.....	.....	.....	2.47	
Sarcoxie	.....	.....	.....	14.90	
Sedalia	92	56	73.6	7.07	
Seymour	90	53	71.2	16.82	
Sikeston	93	58	74.7	7.17	
Steffenville	92	55	73.2	6.63	
Sublett	95	50	72.0	9.17	
Trenton	93	54	73.0	5.47	
Unionville	96	83	72.6	5.65	
Versailles	95	54	73.9	7.20	
Vichy	93	50	73.0	4.86	
Warrensburg	95	55	74.5	8.52	
Warrenton	95	55	74.1	4.95	
Warsaw	93	49	72.5	7.88	
Wheatland	.....	.....	.....	7.09	
Willowsprings	90	51	71.6	12.64	
Windsor	94	53	73.0	7.68	
Zeitonia	95	56	74.5	14.60	
Montana.					
Absarokee	.....	.....	.....	0.50	
Adel	88	35	60.0	1.03	
Alzada	.....	.....	.....	3.21	
Anaconda	91	38	63.4	.....	
Augusta	91	37	62.0	1.70	
Billings	100	46	69.8	0.61	
Boulder	89	32	62.7	2.04	
Butte	88	40	63.8	1.80	
Canyon Ferry	95	45	69.0	0.84	
Cascade	95	44	68.5	1.04	
Chinook	98[b]	46[b]	69.9[b]	2.66	
Choteau	98	34	65.3	1.25	
Clearcreek	91	44	66.1	1.18	
Columbia Falls	96	34	64.9	0.38	
Copper	.....	.....	.....	3.13	
Crow Agency	96	44	69.4	0.45	
Culbertson	90	41	66.7	1.99	
Dayton	98	55	63.9	0.46	
Decker	97	41	68.6	0.91	
Dillon	87	41	63.3	1.36	
Ekalaka	91	44	67.4	3.30	
Fallon	94	48	69.2	1.40	
Forsyth	96[a]	46	70.6[a]	2.38	
Fort Benton	96	47	70.3	1.42	
Fort Harrison	94	43	68.4	.....	
Fort Logan	90	25	59.4	1.05	
Glasgow	90	46	68.0	2.47	
Glendive	.....	.....	.....	2.87	
Gold Butte	.....	.....	.....	1.88	
Graham	.....	.....	.....	3.38	
Grayling	83	25	53.8	1.21	
Greatfalls	93	48	68.4	0.67	
Hamilton	94	42	67.0	0.38	
Hayden (near)	101[d]	38[d]	68.4[d]	1.11	
Highwood	.....	.....	.....	1.62	
Homepark	.....	.....	.....	0.70	
Jordan	90	40	67.5	1.30	
Lakeview	.....	.....	.....	2.20	
Lame Deer	93	43	68.0	1.73	
Lewistown	95	41	64.8	1.20	
Livingston	93	41	66.7	1.57	
Lodgegrass	95[d]	40[d]	68.3[d]	0.63	
Malta	93	50	69.4	2.29	
Marysville	89	42	63.3	1.96	
Missoula	98	39	69.4	1.13	
Neihart	.....	.....	.....	2.05	
Nye	.....	.....	.....	1.47	
Ovando	93	32	62.0	0.95	
Parrot	94	45	67.4	.....	
Philipsburg	90	36	62.0	1.26	
Plains	98	40	66.3	0.88	
Poplar	90	48	68.7	1.99	
Raymond	.....	.....	.....	0.18	
Redlodge	88	38	61.0	0.79	
Ridgelawn	91	43	67.2	1.35	
St. Peter	86	42	63.4	0.84	
Saltese	.....	.....	.....	0.00	
Springbrook	90	43	66.7	1.60	
Steele	92	49	67.9	1.56	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Montana—Cont'd.	°	°	°	*Ins.*	*Ins.*
Toston	93	44	70.4	0.56	
Townsend	.....	.....	.....	1.34	
Troy	101	35	66.2	1.26	
Twin Bridges	96	35	63.8	1.10	
Utica	92	44	64.2	3.19	
Virginia City	88	38	64.4	1.55	
Warrick	.....	.....	.....	2.19	
Whitlash	.....	.....	.....	2.70	
Wolf Creek	95	40	68.7	0.79	
Wolf Point	.....	.....	.....	2.51	
Wolsey	87	33	57.7	1.41	
Yale	93	42	66.3	2.38	
Nebraska.					
Agate	91	38	65.1	2.22	
Agee[s]	98	54	69.2	3.51	
Albion	93	45	69.2	1.93	
Alliance	92	44	69.6	4.74	
Alma	95	44	71.3	7.15	
Ansley	96	42	71.6	2.77	
Arapaho	.....	.....	.....	10.93	
Arcadia	.....	.....	.....	5.82	
Ashland	100	49	72.8	2.73	
Ashton	.....	.....	.....	6.46	
Auburn	95	47	71.5	4.42	
Aurora	98	46	72.0	6.53	
Bartley	100	42	72.7	5.10	
Beatrice	99	47	73.6	2.98	
Beaver	95	47	72.8	13.90	
Bellevue	.....	.....	.....	3.34	
Benkleman	.....	.....	.....	4.00	
Blair	95	47	71.2	2.87	
Bluehill	.....	.....	.....	6.37	
Bradshaw	.....	.....	.....	8.26	
Bridgeport	94	45	68.1	3.87	
Broken Bow	96	40	69.2	5.41	
Burchard	.....	.....	.....	3.86	
Burge	.....	.....	.....	6.29	
Burwell	.....	.....	.....	4.22	
Callaway	94	41	70.0	3.10	
Central City	.....	.....	.....	5.79	
Chester	.....	.....	.....	5.90	
Clearwater	96	45	70.0	2.41	
Cody	.....	.....	.....	4.38	
Columbus	98	45	71.4	2.62	
Crawford	.....	.....	.....	4.94	
Crete	97	48	72.9	4.00	
Culbertson	101	50	75.2	5.09	
Curtis	95	46	69.9	7.26	
David City	95	48	70.4	3.03	
Dawson	98	50	73.6	5.38	
Duff	.....	.....	.....	2.30	
Dunning	.....	.....	.....	3.75	
Edgar	.....	.....	.....	6.03	
Ericson	.....	.....	.....	2.30	
Ewing	.....	.....	.....	2.09	
Fairbury	99	44	72.5	8.59	
Fairmont	97	47	71.2	4.76	
Fort Robinson	97	41	66.4	3.92	
Franklin	100	44	72.0	9.41	
Fremont	100	47	71.8	1.83	
Fullerton	.....	.....	.....	3.62	
Geneva	99	48	72.4	3.87	
Genoa (near)	95	49	71.4	3.64	
Gering	96	50	70.0	2.87	
Gordon	.....	.....	.....	4.00	
Gothenburg	97	42	70.8	4.84	
Grand Island	97	53	73.8	6.48	
Grant	99	42	69.4	4.28	
Greeley	.....	.....	.....	3.45	
Guide Rock	.....	.....	.....	9.11	
Halsey	98	39	69.4	4.75	
Hartington	94	45	68.3	3.55	
Harvard	95	46	70.0	4.99	
Hastings[s]	96	60	72.6	3.27	
Hayes Center	98	44	70.8	5.39	
Hay Springs	94	42	66.4	4.81	
Hebron	96	48	72.1	6.22	
Hendley	.....	.....	.....	10.35	
Hickman	.....	.....	.....	5.08	
Holbrook	.....	.....	.....	9.85	
Holdrege	95	42	73.8	6.21	
Holly	.....	.....	.....	5.30	
Hooper[s]	102	52	72.4	1.84	
Imperial	96	41	68.6	6.38	
Kearney	93	46	71.6	5.22	
Kennedy	98	45	69.2	7.58	
Kimball	91	41	67.6	3.48	
Kirkwood	98	43	69.4	2.03	
Leavitt	102	45	73.0	1.36	
Level	.....	.....	.....	4.41	
Lexington	96	45	69.8	2.84	
Lodgepole	90	45	66.0	8.07	
Loup	96	43	70.4	4.15	
Lynch	100	44	70.0	3.23	
McCook	.....	.....	.....	10.86	
McCool	.....	.....	.....	6.18	
Madison[t]	99	45	70.2	1.82	
Marquette	.....	.....	.....	5.59	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Nebraska—Cont'd.	°	°	°	*Ins.*	*Ins.*
Mason	.....	.....	.....	2.46	
Merriman	.....	.....	.....	5.54	
Minden	95	44	70.0	6.26	
Monroe	.....	.....	.....	3.70	
Nebraska City	96	50	72.2	5.64	
Nemaha	.....	.....	.....	3.40	
Norfolk	99	44	70.8	4.31	
North Loup	95	44	69.9	8.80	
Oakdale	99	47	71.1	2.74	
Oakland	99	44	71.3	3.27	
Odell	.....	.....	.....	6.03	
Ord	.....	.....	.....	5.48	
Osceola	.....	.....	.....	3.54	
Palmer	.....	.....	.....	9.20	
Palmyra[s]	98	56	72.9	4.20	
Pawnee City	98	45	73.0	5.10	
Plattsmouth	.....	.....	.....	4.96	
Plymouth	96	48	72.1	5.60	
Purdum	99	40	69.4	3.14	
Ravenna	96	43	70.6	2.61	
Redcloud	97	50	72.3	7.91	
Republican	.....	.....	.....	4.32	
St. Libory	.....	.....	.....	6.56	
St. Paul	96	47	72.1	7.47	
Santee	97	48	71.7	5.40	
Schuyler	.....	.....	.....	2.39	
Seward	99	45	72.4	3.45	
Smithfield	.....	.....	.....	8.78	
Springview	97	45	68.7	3.53	
Stanton	100	44	71.8	3.25	
Strang	.....	.....	.....	5.31	
Stratton	.....	.....	.....	4.85	
Stromsburg	.....	.....	.....	3.65	
Superior	100	47	71.1	5.98	
Syracuse	.....	.....	.....	6.13	
Tablerock	.....	.....	.....	4.49	
Tecumseh	99	48	73.2	4.34	
Tekamah	100	51	74.7	1.88	
Turlington	94	50	71.8	5.73	
University Farm	99	48	72.6	2.82	
Wahoo	.....	.....	.....	1.97	
Wakefield	101	43	70.0	1.35	
Wallace	.....	.....	.....	4.75	
Wauneta	.....	.....	.....	9.38	
Weeping Water	.....	.....	.....	3.33	
Westpoint	101	45	70.8	1.48	
Whitman	.....	.....	.....	4.63	
Wilber	.....	.....	.....	4.77	
Wilsonville	.....	.....	.....	8.22	
Winnebago	97	39	68.8	1.20	
Wisner	.....	.....	.....	1.95	
Wymore	.....	.....	.....	5.00	
York	98	45	71.4	4.39	
Nevada.					
Amos	105	37	72.0	0.00	
Austin	92	40	69.8	0.03	
Battle Mountain	105	44	73.8	0.00	
Belmont	93	47	69.6	T.	
Carlin[s]	100	60	76.0	T.	
Carson City	97	39	68.1	0.00	
Eureka	99	58	79.8	T.	
Geyser	98[c]	32[c]	65.8[c]	0.10	
Golconda	.....	.....	.....	0.00	
Halleck	.....	.....	.....	0.40	
Hawthorne	102	45	78.5	0.00	
Hazen	105	54	78.8	0.00	
Humboldt	100	50	77.2	0.00	
Lewers Ranch	98	40	69.2	0.02	
Lovelocks	106	40	74.8	T.	
Martins	109	32	72.4	0.00	
Mill City[s]	100	58	72.9	0.00	
Morey	95	42	70.0	T.	
Palisade	98	40	68.2	0.00	
Palmetto	95	38	66.4	0.03	
Pioche	105	36	72.2	0.24	
Potts	102	31	65.8	T.	
Reno State University	98	45	71.6	0.05	
San Jacinto	100	34	67.2	0.09	
Sodaville	109	54	81.0	0.00	
Tecoma	103	42	73.6	0.26	
Wabuska	101	40	71.3	0.00	
Wadsworth	.....	.....	.....	0.00	
Wells[s]	99	46	70.5	0.00	
Wood	91	40	66.8	0.07	
New Hampshire.					
Bartlett	.....	.....	.....	9.49	
Berlin Mills	90	39	63.8	5.95	
Bethlehem	86	45	66.6	6.00	
Bretton Woods	.....	.....	.....	3.92	
Brookline[s]	98	45	73.2	2.13	
Durham	95	47	70.8	2.50	
Franklin Falls	94	44	70.2	4.33	
Grafton	90	38	67.2	4.56	
Hanover	91	43	69.2	6.67	
Keene	96	40	70.2	1.35	
Littleton	86	50	68.7	3.57	
Nashua	96	47	27.8	1.31	
Newton	91	42	70.4	2.42	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
New Hampshire—Cont'd.	°	°	°	*Ins.*	*Ins.*
North Woodstock				5.04	
Plymouth	95	42	70.5	4.04	
Stratford	92	39	67.8	4.80	
New Jersey.					
Asbury Park	100	57	73.0	5.82	
Bayonne	98	57	75.0	5.26	
Belvidere	96	50	74.4	4.10	
Bergen Point	97	55	74.6	5.90	
Beverly	99	54	76.2	2.27	
Bridgeton	100	57	77.2	4.79	
Browns Mills	99[b]	48[m]	72.3[b]	2.56	
Canton				5.16	
Cape May C. H	97	58	75.4	4.12	
Charlotteburg	93	42	70.9	3.66	
Chester	95	48	72.6	5.27	
Clayton				3.18	
College Farm	100	51	74.6	4.23	
Dover	95	47	71.8	5.57	
Englewood	95	54	72.8	6.32	
Flemington	100	50	75.8	3.25	
Friesburg	98	54	75.0	4.22	
Hightstown	97	50	73.7	3.37	
Imlaystown	97	56	75.9	2.87	
Indian Mills	100	51	75.4	2.20	
Lakewood	95	53	73.2	6.16	
Lambertville	98	53	75.7	2.95	
Layton	95	42	71.4	3.06	
Moorestown	96	55	75.2	2.85	
Newark	97	56	74.8	6.27	
New Brunswick	100	54	76.8	3.69	
Newton	93	47	72.6	6.08	
Oceanic	95	57	73.2	5.53	
Paterson	99	56	75.8	5.17	
Phillipsburg	98	53	75.6	2.69	
Plainfield	98	51	74.9	8.19	
Pleasantville				2.34	
Rancocas				3.63	
Rivervale	99	45	72.4	3.90	
Salem	98	53	75.9	3.63	
Sandy Hook	99	60	71.4	5.53	
Somerville	102	51	74.9	5.03	
South Orange	96	53	73.9	4.58	
Sussex	96	49	73.2	3.47	
Toms River	100	47	73.6	2.61	
Trenton	96	60	77.0	2.44	
Tuckerton	100	52	74.6	2.14	
Vineland	98	52	75.0	3.59	
Woodbine	99	54	74.6	2.49	
Woodstown				3.26	
New Mexico.					
Alamagordo	102	54	77.1	2.88	
Albert	100	49	75.0	1.48	
Albuquerque	99	51	74.6	0.22	
Alma	102	45	72.8	1.85	
Alto				7.39	
Arabela	96	48	69.6	6.59	
Artesia	103	52	76.4	6.31	
Bellranch	102	53	75.2	3.06	
Bloomfield	97	43	73.1	0.54	
Brice	101	59	77.8	3.72	
Cambray				0.75	
Carlsbad	109	53	79.0	3.86	
Chama				1.31	
Cimarron	87	41	64.6	2.88	
Cliff	107	46	75.6	2.70	
Colmor	83	56	66.9	1.12	
Deming				0.90	
Dorsey	95	42	67.3	1.63	
Eagle Rock Ranch	88	42	65.8	4.11	
Elizabethtown	81	31	57.0	3.57	
Elk				15.10	
Engle				0.38	
Espanola	96[c]	41[c]	70.8[c]	1.18	
Fairview	106	41	72.4	2.50	
Fort Bayard	99	52	71.0	3.84	
Fort Stanton	92	43	66.6	5.62	
Fort Union	93	40	64.6	1.07	
Fort Wingate	87	46	66.7	1.15	
Fruitland	96	43	71.8	1.26	
Gage				1.17	
Gallinas Spring	103	50	77.0	2.85	
Gran Quivira				2.29	
Hillsboro	100	52	73.8	1.56	
Laguna	97	50	72.2	0.73	
Lagunita	101	47	72.6	3.87	
Lake Valley				2.70	
Las Vegas	95	42	67.8	1.70	
Lordsburg	108	55	79.2	2.10	
Los Alamos				2.01	
Los Lunas	98	57	77.7	0.50	
Luna	95	35	65.5	1.98	
Magdalina				1.35	
Manuelito				0.94	
Mesilla Park	105	51	77.6	1.83	
Mimbres				3.15	
Mineral Hill				2.87	
Portales	100[c]	50[c]	75.2[c]	3.60	
Raton				1.84	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
New Mexico—Cont'd.	°	°	°	*Ins.*	*Ins.*
Redrock				2.88	
Rincon	103	53	77.0	1.48	
Rociada	85	36	60.4	1.94	
Rosa				0.60	
Rosedale				2.25	
Salado				1.14	
San Marcial	105	51	77.1	T.	
San Rafael	99	42	69.4	0.95	
Socorro	102	49	75.2	0.84	
Springer	99	41	69.4	0.80	
Taos	96	38	67.8	2.94	
Trampas				1.70	
Tres Piedras	87	36	62.4	2.31	
Tucumcari	101[d]	58[d]	75.6[d]	4.07	
Valley				2.46	
Vermejo	83	38	59.8	4.66	
Weed				7.45	
Whiteoaks				2.47	
Winsors	82	30	56.5	2.46	
New York.					
Adams				7.50	
Addison	94	46	71.8	2.82	
Akron				5.87	
Ames	92	43	70.0	5.67	
Amsterdam	91	47	70.0	4.18	
Appleton	93	50	70.8	4.02	
Arcade	87	43	68.0	4.72	
Athens	99	52	74.4	1.55	
Atlanta	90	40	69.3	7.54	
Atwater				3.25	
Auburn	92	50	71.1	3.01	
Avon	91	47	71.6	3.37	
Baldwinsville	91	50	71.3	6.90	
Ballston Lake	91	46	70.0	3.91	
Bedford	98	51	74.2	4.71	
Blue Mountain Lake				5.71	
Bolivar	91	41	68.7	6.77	
Bouckville	88	42	68.4	5.50	
Brockport	92	50	72.5	6.53	
Cape Vincent	85	53	69.0	6.40	
Carmel	93	55	73.0	3.79	
Chatham	96	48	73.6	2.08	
Chazy	89	51	69.6	9.39	
Coeymans	99	50	75.4	0.67	
Cold Spring Harbor	98	53	74.0	3.42	
Cooperstown	87	46	67.9	6.31	
Cortland	92	50	72.7	2.85	
Cutchogue	95	55	73.4	3.83	
Dekalb	89	45	69.6	5.70	
De Ruyter	87	43	68.0	3.46	
Easton				4.43	
Elba	89	49	70.0	4.35	
Elmira	98	48	73.4	5.73	
Faust	87	44	66.6	7.44	
Fayetteville	93	50	72.0	4.30	
Fort Plain	92	48	72.2	4.24	
Franklinville	88	45	69.2	5.82	
Gabriels	89	36	63.9	3.08	
Gansevoort				4.36	
Glens Falls	90	44	70.4	5.00	
Gloversville	90	47	69.0	5.21	
Greenfield	90	47	69.0	3.75	
Greenwich	89	48	70.0	5.78	
Griffin Corners	86	40	66.2	7.20	
Harkness	89	47	68.3	7.99	
Haskinville				8.52	
Hemlock	88	51	71.3	4.62	
Hunt	89	44	69.3	8.35	
Indian Lake	89	35	67.0	4.80	
Ithaca	90	48	70.4	4.97	
Jamestown	90	48	70.7	6.32	
Jeffersonville	92	42	68.5	4.79	
Keene Valley	90	41	67.0	7.13	
Lake George	94	48	69.8	5.53	
Le Roy	88	48	70.2	3.51	
Liberty	87	49	68.1	4.33	
Littlefalls, City Res	88	50	69.8	5.18	
Lockport	88	50	70.6	4.41	
Lowville	87	42	67.1	4.36	
Lyndonville				3.60	
Lyons	94	49	73.6	4.05	
Middletown	93	54	73.8	2.93	
Mohonk Lake	90	54	69.8	4.75	
Moira	89	47	69.6	10.73	
Mount Hope	99	50	73.4	6.78	
Newark Valley				6.96	
New Lisbon	88	41	66.4	6.19	
North Hammond	89	46	69.7	5.54	
North Lake	87	35	62.0	7.23	
Number Four	83	44	64.8	6.18	
Ogdensburg	89	46	69.8	6.46	
Oneonta	96	44	73.3	4.95	
Oswegatchie				5.99	
Otto	86	50	69.6	3.67	
Oxford	89	48	69.5	6.22	
Palermo				4.00	
Perry City	93	41	69.8	4.98	
Plattsburg	96	40	71.2	8.27	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
New York—Cont'd.	°	°	°	*Ins.*	*Ins.*
Port Jervis	95	48	73.2	4.75	
Potsdam	90	45	69.9	7.37	
Richland	90	46	70.9	4.78	
Richmondville				5.62	
Ripley	91	52	72.4	2.75	
Romulus	92	48	70.6	2.61	
Salisbury Mills	92	50	71.4	4.51	
Saranac	86	43	66.2	5.38	
Setauket	95	57	73.6	4.31	
Shortsville	89	51	70.4	4.14	
Skaneateles				3.04	
Southampton	90	54	71.2	3.45	
South Canisteo	90	44	69.0	3.91	
South Kortright	90	42	68.4	6.53	
South Schroon	90	44	66.4	8.88	
Spier Falls	91	47	69.2	5.32	
Ticonderoga	92	51	71.0	6.74	
Volusia	85	50	68.4	3.83	
Wappinger Falls	96	52	74.1	4.68	
Warwick				4.93	
Watertown	89	49	70.8	6.67	
Waverly	94	43	71.8	7.47	
Wedgwood	89	48	68.8	3.26	
Wells	89	38	66.9	6.55	
West Berne	91	45	70.0	3.45	
Westfield	87	55	70.0	4.94	
Windham	90	42	69.2	2.69	
Youngstown				4.11	
North Carolina.					
Battleboro				6.40	
Brevard	88	57	75.6	7.38	
Brewers	94	52	74.7	9.48	
Bryson				5.47	
Buck Springs	80	52	65.4	10.86	
Catawba				14.34	
Chapelhill [f]	98	60	78.8		
Currituck				5.15	
Eagletown	90	62	76.6	7.08	
Edenton	95	63	78.2	9.47	
Fayetteville	98	64	78.8	7.36	
Goldsboro	96	65	79.6	10.89	
Graham				10.14	
Greensboro	97	60	78.0	10.86	
Greenville				5.93	
Henderson	93	63	77.6	3.89	
Henrietta	96	60	78.3	6.79	
Horse Cove	84	57	70.4	10.56	
Hot Springs	90	57	74.0		
Jefferson	87	50	69.0	12.93	
Kinston	98	62	79.4	4.38	
Lenoir [g]	94	57	74.7		
Lexington	99	59	78.1	5.79	
Lincolnton	97	64	78.5	7.51	
Linville	81	46	65.4	11.21	
Louisburg	93	60	78.2	5.78	
Lumberton	101	65	80.7	4.39	
Marshall	98	58	76.4	8.67	
Moncure	99	56	79.2	5.11	
Monroe	100	60	77.6	4.70	
Morganton	93	61	75.5	13.95	
Mountairy	95	55	75.3	15.92	
Mount Holly				8.34	
Murphy				9.02	
Nashville	97	62	79.0	8.75	
Newbern	95	67	80.3	8.10	
Patterson [i]	89	54	69.4	9.06	
Pinehurst	105	66	80.4	7.66	
Pink Beds	88	45	65.8	13.95	
Pittsboro	98	60	78.8	5.42	
Randleman				7.89	
Reidsville	96	60	77.0	7.28	
Salem	95	58	76.9	8.60	
Salisbury	98	60	78.1	5.69	
Saxon	97	56	75.9	6.44	
Scotland Neck	98	64	80.5	6.44	
Selma	99[c]	68[c]	81.6[c]	7.00	
Settle	93	60	75.4	13.56	
Sloan	96	65	78.8	7.94	
Snowhill	96	60	79.2	4.33	
Southern Pines	99	64	79.7	7.74	
Southport	93	66	80.2	7.82	
Statesville	96	60	76.4	8.95	
Tarboro	97	68	82.2	7.83	
Vade Mecum	94	56	75.6	9.54	
Washington	97	60	79.1	6.81	
Waynesville	87	50	71.0	6.17	
Weldon	98	61	80.2	4.95	
Whiteville	97	62	78.7	8.58	
North Dakota.					
Amenia	93	45	66.6	4.78	
Ashley	90	40	64.0	4.65	
Beriin	98	38	63.9	2.79	
Buford	92	45	67.2	0.68	
Cando	85	32	62.6	4.79	
Churchs Ferry	88	37	64.8	5.73	
Coalharbor	90	44	66.5	3.53	
Cooperstown	89	39	64.8	4.85	
Denhoff	88	42	65.6		

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
North Dakota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Dickinson	100	45	68.2	3.46	
Donnybrook	93	38	65.4	3.75	
Edgeley	94	40	66.1	2.60	
Ellendale	94	42	69.7	3.75	
Elmore	94	33	64.8	3.43	
Fargo	92	42	65.8	5.17	
Forman	95	44	67.0	3.45	
Fort Berthold	91	40	65.8	2.81	
Fort Yates	93	47	67.4	6.60	
Fullerton	95	42	65.2	4.37	
Glenullin	89	46	65.8	4.90	
Hamilton	87	40	65.6	1.96	
Hannaford	94	32	65.8[1]	2.07	
Jamestown	99	43	68.2	3.20	
Kulm	94	43	65.2	4.76	
LaFollette	88	41	63.2	5.24	
Lamoure				5.02	
Langdon	86	45	64.6	2.21	
Larimore	91	41	64.2	5.20	
Lisbon	92	40	65.8	2.51	
McKinney	88	36	62.1	3.02	
Manfred	90	35	65.4	2.03	
Mayville	92	42	66.2	6.85	
Medina	88	36	66.0	3.84	
Medora	94	48[d]	68.0[b]	4.91	
Milton	93	40	62.0	1.54	
Minnewaukon	89[d]	42[d]	65.8[d]	6.91	
Minot	89	41	64.9	2.79	
Minto	84	41	63.7	5.03	
Moyersville	88	40	64.2	1.44	
Napoleon	90	38	65.0	4.36	
New England	98	40	70.2	4.65	
Oakdale	89	46	66.8	5.96	
Oriska	93	45	66.0	6.80	
Park River	87	43	66.4	3.52	
Pembina	85	36	64.8	0.92	
Portal [b]	85	44	63.6		
Power	93	33	65.0	4.74	
Pratt	88	38	63.4	4.39	
Rolla	86	41	64.6	3.69	
Rugby	88	41	65.2	6.45	
Sentinel Butte	93	50	71.2	1.93	
Steele	88	38	65.3	3.50	
Tioga	92	39	65.8	2.16	
University	90	41	65.6	5.49	
Wahpeton	92	44	66.8	5.93	
Walhalla	95	39	66.0	0.76	
Washburn	92	40	67.0	2.57	
Westhope [b]	90	39	63.8		
Willow City	89	38	62.7	3.80	
Wishek	88	41	64.3	4.90	
Ohio.					
Akron	92	52	72.4	3.97	
Amesville	97	50	75.8	3.36	
Atwater				6.39	
Bangorville	94	48	71.8	5.88	
Bellefontaine	92	47	71.6	2.21	
Benton Ridge	93	49	73.1	4.31	
Bladensburg	100	50	71.2	5.04	
Bowling Green	92	48	71.8	4.70	
Bucyrus	92	48	71.7	5.81	
Cadiz	94	51	73.5	5.30	
Cambridge	92	48	72.8	3.04	
Camp Dennison	96	52	75.2	2.80	
Canal Dover	93	44	71.4	4.83	
Canton	91	52	72.0	5.85	
Cardington	94	48	71.4	4.28	
Chillicothe	93	50	72.6	3.68	
Circleville	96	53	75.2	3.88	
Clarington	96	53	75.2	3.81	
Clarksville	93	51	74.8	1.78	
Cleveland *a*	89	56	72.0	5.66	
Cleveland *b*	93	56	72.8	4.79	
Coalton	94	49	73.9	2.69	
Colebrook	87[d]	47[d]	69.6[d]	7.65	
Dayton	96	51	74.8	3.23	
Defiance	93	49	71.8	4.28	
Delaware	93	49	72.6	3.50	
Demos	95	53	73.2	2.47	
Findlay	99	50	74.7	4.37	
Frankfort	95	52	75.8	3.82	
Fremont	96	51	73.8		
Garrettsville	91	45	70.2	4.78	
Granville	96	50	73.4	1.94	
Gratiot	91	50	72.2	3.39	
Green	95	54	75.1	6.63	
Greenhill	91	46	70.4	4.68	
Greenville	96	50	73.8	1.45	
Hedges	95	49	72.5	5.47	
Hillhouse	89	50	70.2	6.42	
Hiram	89	54	71.4	5.85	
Hudson	95	47	72.2	5.83	
Ironton	97	54	76.6	6.66	
Jacksonburg	97	54	74.8	4.15	
Killbuck	93	51	72.0	4.90	
Lancaster	93	52	73.8	2.75	
Lima	92	58[b]	74.8[d]	4.12	
McConnelsville	96	53	73.8	3.79	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Ohio—Cont'd.	°	°	°	*Ins.*	*Ins.*
Manara	92	50	72.6	2.63	
Mansfield				5.30	
Marietta	90	56	74.6	3.22	
Marion	95	48	73.2	4.26	
Medina	95	50	72.0	6.75	
Milfordton	95	48	70.7	2.94	
Milligan	95	48	72.7	2.76	
Millport	91	47	70.6	5.83	
Montpelier	94	49	71.9	3.62	
Napoleon	93	50	71.9	4.93	
Nellie	91	50	71.0	5.79	
New Alexandria	95	50	73.8	4.25	
New Berlin	95	50	72.4	5.02	
New Bremen	95	47	73.2	1.27	
New Richmond	93	55	75.0	2.54	
New Waterford	97	50	73.1	4.21	
North Lewisburg	96	52	74.2	5.05	
North Royalton	92	50	71.3	6.16	
Norwalk	96	49	73.2	6.14	
Oberlin	94	47	71.8	3.05	
Ohio State University	93	50	72.8	3.76	
Orangeville	91	45	70.8	6.99	
Ottawa	95	49	73.0	4.14	
Pataskala	93	52	73.4	2.01	
Philo	96	54	74.6	2.01	
Plattsburg	91	50	72.0	4.22	
Pomeroy	96	51	74.8	4.50	
Portsmouth	94	55	76.4	3.16	
Pulse	90	51	72.8	1.92	
Rittman	94	48	71.8	4.98	
Rockyridge	96	49	73.6	2.03	
Shenandoah	91	49	70.4	6.83	
Sidney	94	50	74.2	2.39	
Somerset	97	53	74.8	3.33	
South Lorain	93	45	72.5	1.66	
Springfield				2.74	
Thurman	95	52	75.8	4.25	
Tiffin	93	53	72.6	3.68	
Upper Sandusky	92	49	72.7	4.89	
Urbana	92	50	73.4	2.71	
Vickery	95	47	72.5	2.28	
Warren	93	49	72.6	6.51	
Wauseon	94	48	71.8	3.57	
Waverly	96	52	75.8	1.78	
Waynesville	91	53	73.5	2.83	
Wellington	96	49	73.1	2.41	
Willoughby				4.36	
Wilson	94	50	75.0	1.98	
Wooster	92	50	71.6	5.14	
Zanesville				1.74	
Oklahoma.					
Alva				3.25	
Arapaho	102	51	78.6	2.51	
Binger	97[b]		77.8[b]	4.65	
Blackburn	97	54	76.6	1.95	
Chandler	97	50	80.2	5.68	
Cleo	102[g]	82[g]	78.9[g]	1.99	
Cloud Chief	102	52	77.0	2.72	
Enid	99	53	76.9	5.70	
Erick	100	50	77.4	4.00	
Fort Reno	97	54	76.4	5.72	
Fort Sill	99	62	78.6	3.90	
Frederick	100	58	80.7	1.80	
Gage	97	49	76.4	4.11	
Grand	100	47	77.2	3.27	
Guthrie	94	54	77.0	5.42	
Harrington	96	50	75.0	1.91	
Hennessey	96	58	76.8	10.47	
Hobart	100			3.04	
Jefferson	103	55	80.8	3.10	
Jenkins	102	53	77.7	5.02	
Kenton	96	46	73.7	2.14	
Kingfisher	100	54	77.9	6.43	
Luther	103	55	80.1	6.50	
McComb	95	55	75.5	10.12	
Mangum	101	58	81.1	2.10	
Meeker	95	57	77.5	6.76	
Newkirk	99	50	78.6	1.64	
Norman	94	53	76.4	6.75	
Okeene	100	54	79.0	3.73	
Perry	99	51	77.6	1.93	
Sac and Fox Agency	93[i]	56	77.2[c]	4.96	
Shawnee	95	55	78.8	7.43	
Stillwater	96	55	77.4	3.19	
Taloga				2.51	
Temple	100	54	80.2	5.11	
Watonga	100[c]	50[c]	77.2[c]	2.79	
Waukomis	98	50	77.7	7.96	
Weatherford	101	52	77.4	2.27	
Whiteagle	96	56	77.4	5.43	
Oregon.					
Alba				0.36	
Albany				0.11	
Alpha	106	40	65.0	0.48	
Arlington	107	50	77.0	T.	
Ashland	104	47	73.5	0.00	
Astoria	94	50	62.2	0.34	
Aurora (near)	98	46	66.4	0.00	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Oregon—Cont'd.	°	°	°	*Ins.*	*Ins.*
Bay City	98	42	59.0	0.40	
Bend	102	30	65.2	0.31	
Beulah	112	32	70.0	0.60	
Blackbutte	97	42	67.2	0.00	
Blalock	114	54	82.5	0.30	
Bonita	104	44	69.7	0.02	
Bullrun				0.30	
Burns	99	41	70.1	0.01	
Carlton	101	43	66.5	0.33	
Cascade Locks	97	48	70.6	0.00	
Coquille				0.08	
Corvallis	102	46	68.4	T.	
Dale				0.61	
Dayville	101	44	70.7	0.24	
Doraville	97	45	65.8	0.22	
Drain	107	39	67.8	0.00	
Echo	112	48	77.6	0.00	
Ella	110	52	78.0	0.04	
Eugene	98	47	67.0	0.12	
Fairview	106	42	62.3	0.06	
Falls City	99	43	65.4	0.03	
Forestgrove	99	43	67.4	0.00	
Gardiner	102	47	60.6	0.18	
Glendale	107	40	69.2	0.00	
Glenora	101	37	64.9	0.18	
Gold Beach	88	41	60.4	0.00	
Government Camp	91	36	58.2	0.67	
Granite				0.72	
Grants Pass	110	40	73.6	0.00	
Grass Valley	106	34	66.0	0.36	
Heisler	101	42	69.9		
Heppner	107[e]	40[e]	73.5[e]	0.30	
Hood River	95	49	70.8	0.05	
Huntington	108	55	80.2	0.00	
Jacksonville	106	46	73.0	0.05	
John Day				0.10	
Joseph	96	37	65.1	0.18	
Kerby	107	42	71.4	0.00	
Klamath Falls	103	40	70.6	0.00	
Lagrande	103	43	70.2	0.05	
Lakeview	105	40	71.4	0.00	
Lonerock	100	34	64.8	0.42	
McKenzie Bridge	107	35	67.6	0.52	
McMinnville	100	42	66.8	0.02	
Marshfield	98	42	61.4	0.09	
Mill City	104	38	64.6	0.00	
Monroe	99[d]	45[d]	67.1[d]	0.08	
Mount Angel	104	50	69.8	0.05	
Nehalem				0.67	
Newport	97	45	57.4	0.86	
Odell				0.07	
Ontario				T.	
Paisley	98	39	69.8	0.00	
Pendleton	114	44	74.6	0.05	
Port Oxford	86	50	58.9	0.04	
Pine	102	34	68.8	0.16	
Prineville	111	37	67.0	T.	
Riverside	111	34	74.3	0.27	
Salem	100	50	68.8	0.05	
Silverlake	109	30	64.6	0.05	
Sparta	106	39	71.2	0.05	
Stafford	100	45	67.4	0.13	
The Dalles	101	47	72.8	0.19	
Toledo	98	42	61.0	0.52	
Umatilla	115	53	80.4	0.00	
Vale	106	46	75.4	0.00	
Wallowa	103	35	66.0	0.17	
Wamic	102	35	66.2	0.00	
Warm Spring	109	44	73.0	0.53	
Weston	104	43	70.2	0.03	
Williams	107	32	69.8	0.00	
Pennsylvania.					
Aleppo	92	47	72.4	3.20	
Altoona	92	46	69.9	4.72	
Beaver Dam				2.53	
Bellefonte	95	47	73.1	3.72	
Brookville				7.46	
Browers				4.80	
California	95	55	73.9	5.29	
Cassandra	90	45	68.4	3.80	
Centerhall	91	48	71.4	3.73	
Clarion				8.70	
Claysville	96	49	73.8	3.71	
Coatsville	98	55	75.3	4.24	
Confluence				6.43	
Coudersport	90	39	68.2	4.60	
Davis Island Dam				5.19	
Derry	93	46	73.0	5.89	
Doylestown				2.88	
East Mauch Chunk	98	46	73.9	2.50	
Easton	97	52	75.4	3.21	
Ellwood Junction				4.34	
Emporium	91	48	71.4	4.90	
Ephrata	98	51	74.4	3.74	
Everett	91	47	70.9	3.45	
Forks of Neshaminy				2.67	
Franklin	91	46	71.1	8.57	
Freeport	97	51	73.8	7.13	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Pennsylvania—Cont'd.	°	°	°	*Ins.*	*Ins.*
Gettysburg	96	51	74.6	6.90	
Girardville	.....	.....	.....	5.27	
Gordon	93	43	71.0	4.39	
Greensboro	.....	.....	.....	5.97	
Greenville	93	46	71.8	9.78	
Hamburg	96	51	74.9	5.49	
Hanover	99	53	75.8	6.60	
Herrs Island Dam	.....	.....	.....	9.19	
Huntingdon	95	40	72.0	4.85	
Indiana	91	50	71.0	6.29	
Irwin	96	49	74.0	5.53	
Johnstown	95	52	73.2	8.88	
Keating	.....	.....	.....	5.59	
Kennett Square	94[k]	.....	76.2[k]	4.38	
Lansdale	.....	.....	.....	2.81	
Lawrenceville[c]	95	41	70.6	.....	
Lebanon	97	49	74.0	4.92	
Leroy	92	49	70.0	4.12	
Lewisburg	95	49	72.9	5.99	
Lockhaven	98	50	73.8	4.13	
Lock No. 4	.....	.....	.....	5.31	
Lycippus	92	55	72.6	6.24	
Marion	95	52	73.7	6.11	
Mifflintown	93	49	72.6	7.22	
Milford	98	44	71.6	3.74	
Montrose	90	47	69.0	3.62	
New Germantown	93	50	72.2	6.06	
Ottsville	.....	.....	.....	4.39	
Parker	.....	.....	.....	7.42	
Philadelphia	98	60	76.5	3.39	
Pocono Lake	87	40	67.1	4.79	
Point Pleasant	.....	.....	.....	3.55	
Pottsville	.....	.....	.....	3.96	
Reading	96	51	75.2	3.21	
Saegerstown	89	44	70.4	5.17	
St. Marys	89	45	69.1	4.50	
Saltsburg	.....	.....	.....	5.20	
Seisholtzville	.....	.....	.....	3.60	
Selinsgrove	96	48	73.2	3.26	
Shawmont	.....	.....	.....	3.79	
Skidmore	93	47	72.2	6.54	
Smiths Corners	.....	.....	.....	3.85	
Somerset	89	40	67.4	6.19	
South Eaton	93	49	71.6	3.42	
Springdale	.....	.....	.....	5.72	
Springmount	.....	.....	.....	2.49	
State College	88	51	70.0	3.86	
Swarthmore	97[d]	55[d]	74.6[d]	4.30	
Towanda	94	44	71.2	3.28	
Uniontown	91	52	72.8	5.21	
Warren	90	45	70.4	8.84	
Wellsboro	94	44	70.8	.....	
Westchester	97	57	75.8	3.86	
West Newton	.....	.....	.....	7.74	
Wilkesbarre	95	50	73.9	3.57	
Williamsport	93	51	72.8	5.95	
Rhode Island.					
Bristol	87	57	70.6	2.77	
Kingston	92	50	70.3	3.71	
Narragansett	89	53	69.6	2.75	
Pawtucket	98	60	77.0	1.45	
Providence[a]	97	60	76.8	2.72	
South Carolina.					
Anderson	97	64	79.9	5.82	
Barksdale	96	64	77.8	10.25	
Beaufort	96	70	81.1	10.65	
Bowman	101	67	81.7	6.41	
Calhoun Falls	.....	.....	.....	14.29	
Camden	.....	.....	.....	5.10	
Cheraw	97	67	79.4	5.83	
Clarks Hill	100	65	80.8	4.38	
Clemson College	94	62	79.2	7.29	
Conway	96	65	80.2	7.15	
Darlington	100	60	78.9	5.03	
Dillon	101	63	81.4	4.17	
Due West	95	63	79.7	6.16	
Edisto	.....	.....	.....	4.90	
Effingham	.....	.....	.....	0.90	
Ehoree	.....	.....	.....	6.20	
Florence	100	66	81.2	4.11	
Gaffney	100	64	80.8	7.74	
Georgetown	93	68	80.3	8.56	
Heath Springs	100	64	80.8	4.52	
Kingstree	99	71	82.7	6.66	
Liberty	96	63	79.4	4.18	
Little Mountain	100	61	81.2	4.09	
Newberry	100	67	82.2	4.69	
Pelzer	.....	.....	.....	5.51	
Pinopolis *[1]	93	68	77.8	5.69	
St. George	98	67	81.0	3.15	
St. Matthews	95	67	79.9	2.90	
St. Stephens	.....	.....	.....	7.89	
Saluda	100	64	81.2	5.69	
Santuck	98	64	79.7	5.21	
Seivern	99	63	80.5	6.16	
Smiths Mills	.....	.....	.....	3.86	
Society Hill	98	68	81.1	7.58	
Statesburg	98	68	80.8	5.78	
Summerville	96	67	79.5	6.84	
Trenton	99	65	81.1	5.79	
Trial	99	67	80.7	3.54	
Walhalla	94	60	77.1	13.60	
Walterboro	100	66	81.5	5.85	
Winnsboro	101	68	80.4	5.04	
Winthrop College	98	66	79.8	5.77	
Yemassee	99	66	80.8	6.09	
Yorkville	101	67	81.4	9.15	
South Dakota.					
Aberdeen	99	43	67.5	4.67	
Academy	98	48	69.7	2.81	
Alexandria	95	45	70.7	2.97	
Armour	98	44	72.4	1.72	
Ashcroft	100	43	66.6	4.18	
Bowdle	91	45	67.0	4.91	
Brookings	93	41	66.0	0.98	
Canton	97	41	68.6	1.43	
Centerville	97	41	69.4	1.00	
Chamberlain	100	45	70.8	1.43	
Clark	91	43	67.8	4.59	
Clear Lake	92	46	67.2	4.22	
Desmet	91	41	67.2	4.46	
Doland	90	44	67.6	3.85	
Elkpoint	101	44	71.8	1.03	
Fairfax	97	47	71.4	3.03	
Farmingdale	.....	.....	.....	7.00	
Faulkton	94	44	66.8	3.53	
Flandreau	95	45	66.3	1.45	
Forestburg	96	40	69.6	5.26	
Fort Meade	91	41	64.2	10.33	
Gannvalley	97	49	69.6	5.19	
Grand River School	94	47	68.8	4.65	
Greenwood	96	47	71.4	2.64	
Highmore	91	47	67.1	5.54	
Hitchcock	.....	.....	.....	1.61	
Hotch City	96	48	68.6	3.07	
Howard	93	46	68.0	3.41	
Howell	95	43	69.2	2.20	
Ipswich	96	42	67.3	5.93	
Kidder	92	40	64.1	3.56	
Kimball	99	48	70.2	2.86	
Leola	93	40	65.9	2.42	
Marion	98[e]	44[e]	69.2[e]	1.75	
Mellette	96	42	68.4	2.09	
Menno	94	44	69.2	2.23	
Mil'bank	92	45	67.4	5.27	
Mitchell	98	45	70.0	3.57	
Oelrichs	93	46	67.4	5.45	
Plankinton	94[f]	49[f]	69.4[f]	3.63	
Ramsey	93	38	67.6	1.65	
Redfield	94	45	67.8	2.21	
Sioux Falls	96	46	70.3	3.31	
Spearfish	91	47	67.1	5.84	
Stephan	97	48	69.4	3.33	
Vermillion	97	50	71.4	2.67	
Watertown	91	44	65.4	5.12	
Wentworth	94	45	68.8	1.83	
Whitehorse	94	49	69.1	4.39	
Wolsey	.....	.....	.....	2.26	
Tennessee.					
Andersonville	93	60	78.9	3.55	
Arlington	99	59	78.2	2.99	
Ashwood	93	55	76.2	1.50	
Benton	95	54	77.1	2.93	
Bluff City	.....	.....	.....	5.75	
Bolivar	93	58	77.6	2.90	
Brownsville	92	67	79.5	2.86	
Byrdstown	90	56	75.2	6.46	
Carthage	94	58	77.0	3.13	
Cedar Hill	97	51	76.6	1.52	
Celina	.....	.....	.....	5.90	
Charleston	.....	.....	.....	3.53	
Clarksville	91	58	76.4	4.63	
Clinton	.....	.....	.....	4.91	
Covington	92	60	78.0	4.37	
Dandridge	.....	.....	.....	4.00	
Decatur	94	56	76.4	3.76	
Dickson	96	54	76.0	4.58	
Dover	97	56	76.7	2.77	
Dyersburg	94	61	78.0	4.20	
Elizabethton	92	55	74.8	4.46	
Erasmus	90	51	71.6	6.47	
Florence	90	60	76.0	3.82	
Franklin	91	57	78.7	4.21	
Goodrich	95	58	77.4	4.08	
Grace	.....	.....	.....	9.00	
Greeneville	91	55	74.7	4.07	
Halls Hill	.....	.....	.....	4.91	
Harriman	92	58	75.6	5.43	
Hohenwald	91	50	72.6	6.83	
Iron City	93	55	76.3	2.97	
Isabella	93	55	76.7	4.09	
Jackson	95	57	78.7	3.42	
Johnsonville	95	56	76.9	4.46	
Jonesboro	92	53	74.2	6.37	
Kenton	91	57	75.4	8.26	
Kingston	.....	.....	.....	5.56	
Lafayette	96	53	76.2	3.87	
Leadvale	.....	.....	.....	4.40	
Lewisburg	95	57	78.3	3.51	
Loudon	.....	.....	.....	2.51	
Lynnville	91	57	76.6	2.41	
McGee	.....	.....	.....	3.30	
McMinnville	94	55	75.8	3.82	
Maryville	96	56	77.2	4.15	
Milan	96	58	77.4	4.82	
Newport	92	58	76.6	4.10	
Pope	99	55	77.6	4.70	
Rogersville	93	55	75.4	5.44	
Rotherwood	.....	.....	.....	7.11	
Rugby	95	59	74.1	6.73	
Savaunah	95	57	77.4	1.70	
Sewanee	87	59	73.6	4.00	
Silver Lake	86	49	69.2	10.09	
Springdale	94	53	76.1	3.63	
Springville	94	54	76.2	3.98	
Tazewell	.....	.....	.....	4.17	
Tellico Plains	92	54	76.6	4.53	
Tracy City	90	51	72.2	4.87	
Trenton	96	57	77.8	4.61	
Tullahoma	94	54	75.8	2.50	
Union City	92	56	76.6	6.23	
Walling	.....	.....	.....	3.41	
Waynesboro	93	54	76.2	2.67	
Wildersville	88	58	75.0	4.98	
Yukon	94	58	77.3	2.16	
Texas.					
Albany	104	54	81.6	5.01	
Alvin	.....	.....	.....	1.94	
Arthur	.....	.....	.....	12.80	
Athens	97	60	80.7	3.75	
Austin	97	62	81.2	2.06	
Ballinger	101	54	81.6	1.86	
Beaumont	.....	.....	.....	4.72	
Beeville	99	61	82.0	1.20	
Bigspring	108	48	81.0	3.40	
Blanco	98	54	79.2	1.61	
Boerne	95	55	78.1	1.30	
Bonham	95	59	79.4	13.91	
Booth	.....	.....	.....	5.27	
Bowie	101	53	80.6	3.50	
Brazoria	99	60	82.7	2.02	
Brenham	96	63	81.4	1.97	
Brighton	.....	.....	.....	0.35	
Brownwood	104	54	82.0	2.06	
Channing	100	49	75.0	2.23	
Childress	97	58	78.6	4.30	
Clarksville	96	60	78.8	13.64	
Claude	94	50	74.0	4.32	
Claytonville	102	50	79.4	4.39	
Coleman	97[e]	56[e]	79.9[e]	3.32	
College Station	100[e]	64[e]	82.2[e]	1.15	
Colorado	107	51	81.6	4.20	
Columbia	92	63	81.5	3.86	
Columbus	.....	.....	.....	4.67	
Comanche	112[b]	54[b]	82.6[b]	2.61	
Comstock	.....	.....	.....	0.96	
Corsicana	100	59	82.0	6.56	
Crockett	97	60	79.0	5.33	
Cuero	102	62	83.8	1.57	
Dallas	98	57	79.5	10.62	
Danevang	96	62	82.2	2.55	
Decatur	95	55	79.4	8.53	
Dialville	92	60	78.1	11.24	
Duval	98	60	80.1	2.62	
Eagle Pass	108	62	88.1	0.24	
Fort Brown	96	68	83.6	2.23	
Fort Clark	103	60	84.6	0.20	
Fort Davis	96	47	72.6	5.48	
Fort McIntosh	106	64	86.4	0.70	
Fort Ringgold	104	67	87.4	0.73	
Fort Stockton	103	50	77.5	2.81	
Fredericksburg	100	63	80.6	2.56	
Gainesville	93	56	77.6	9.89	
Georgetown	103	57	81.2	1.02	
Gonzales	.....	.....	.....	3.39	
Graham	100	54	80.8	5.11	
Grapevine	97	57	79.9[e]	8.31	
Greenville	99	58	80.6	8.28	
Hale Center	95	52	75.6	5.77	
Haskell	104	54	80.0	4.85	
Hearne	100	58	81.3	2.15	
Hempstead	.....	.....	.....	3.24	
Henrietta	101	56	80.0	4.31	
Hereford	.....	.....	.....	3.57	
Hewitt	.....	.....	.....	3.97	
Hillsboro	98	56	80.3	4.34	
Houston	97	63	82.5	2.80	
Hubbard	98	58	80.8	4.67	
Huntsville	99	62	81.9	3.02	
Jefferson	92	62	78.9	10.14	
Jewett	95	50	79.0	3.07	
Junction	.....	.....	.....	1.42	
Kaufman	98	59	81.6	5.75	
Kent	103	53	77.0	1.90	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Texas—Cont'd.	°	°	°	*Ins.*	*Ins.*
Kerrville	101	52	79.4	0.95	
Knickerbocker	109[f]	58	83.6[c]	0.68	
Kopperl				3.31	
Lampasas	106	55	81.4	1.63	
Lapara				0.10	
Laureles Ranch				0.46	
Liberty	98			3.60	
Lone Star Ranch				5.10	
Longlake				6.07	
Longview	96	62	80.8	8.03	
Luling	98	62	82.0	3.11	
McKinney	97	56	79.2	10.92	
Mann	97	59	79.8	9.40	
Marlin	98	59	81.5	3.48	
Memphis	98	60	80.3	2.75	
Menardville	105	48	80.4	1.56	
Mexia	97	59	80.2	2.74	
Miami				3.08	
Mobeetie	96	48	75.6	1.17	
Mount Blanco	95	50	74.7	5.19	
Nacogdoches	93	59	78.4	9.43	
New Braunfels	98	59	80.7	1.81	
Orange				1.80	
Panter				3.68	
Paris	96	58	79.4	8.07	
Pearsall	103	65	85.2	1.40	
Pierce	95	61	80.6	1.97	
Port Lavaca	93	62	81.5	1.88	
Quanah	100	55	83.1	3.25	
Rhineland	100	52	78.1	6.70	
Riverside				4.05	
Rockisland	99	61	81.5	3.52	
Rockland				6.13	
Rockport	90	68	81.0		
Runge	103			1.40	
Sabinal	104	56	83.6	0.39	
San Marcos	98	59	80.4	2.93	
San Saba	103	54	79.6	4.01	
Santa Gertrude				1.20	
Seymour	98	54	79.3	3.71	
Sherman	93	57	79.2	12.00	
Sonora	102	46	80.9	0.20	
Sugarland	97			4.37	
Sulphur Springs	95	60	79.4	8.31	
Temple	100	56	80.2	2.36	
Texline	95	45	70.8	1.33	
Tilden	109	56	85.6[c]	1.04	
Trinity	99	59	80.6	2.92	
Tyler	97	60	80.6	9.58	
Valley Junction				2.25	
Victoria	98	61	82.4	1.31	
Waco	100	61	84.4	3.19	
Waxahachie	97	58	80.4	5.39	
Weatherford	99	56	80.8	4.60	
Wharton	95	62	80.5	2.30	
Wichita Falls				3.17	
Willspoint	95	58	78.8	6.36	
Utah.					
Alpine				0.78	
Alta				0.91	
Aneth	100	49	76.4	0.37	
Beaver				0.47	
Blackrock	98	41	69.9	0.65	
Blacksmith Forks				1.03	
Castledale	93[c]	36	65.4[c]	0.45	
Castle Rock				0.89	
Cisco	100	50	77.6	0.01	
Corinne	103	45	77.1	0.00	
Coyote	92	32	61.0	0.38	
Experiment Farm	107	51	80.7		
Farmington	95	45	72.3	1.05	
Fillmore	106	48	76.6	0.53	
Frisco	101	50	76.0	0.58	
Garrison	97	38	72.6	0.10	
Giles	106	44	74.6	1.50	
Government Creek	99	45	74.7	T.	
Grayson	109	46	74.6	1.25	
Heber	96	35	66.4	0.70	
Henefer	93	33	66.2	0.98	
Hite	106	59	83.6	0.45	
Huntsville				0.59	
Ibapah	98	32	66.2	0.00	
Indianola				0.05	
Kanab	96	40	68.6	0.30	
Kelton	97	45	71.0	0.00	
La Sal	88	42	66.0	0.95	
Levan	96	47	71.9	0.34	
Loa	94	35	64.8	0.06	
Logan	99	41	74.0	0.20	
Lucin	98	48	73.3	0.00	
Manti	95	41	68.4	T.	
Marion				0.91	
Maryavale	92	38	65.3	0.67	
Meadowville	90	38	65.3	0.35	
Millville				0.18	
Minersville	102	39	70.0	0.35	
Moab	102	48	76.0	0.53	
Morgan	93	36	66.3	0.65	
Mount Nebo	100	46	74.2	0.11	
Mount Pleasant	97	43	71.4	0.17	
Nephi				0.37	
Ogden	98	52	75.7	0.19	
Panquitch				1.05	
Parowan	100	41	69.3	0.75	
Payson				0.60	
Pinto	94	36	65.3	1.41	
Plateau	89	32	62.4	0.43	
Ranch	90	35	62.2	2.28	
Randolph				1.24	
Rockville	109	56	83.2	0.95	
St. George	109	55	82.4	1.23	
Salt Air	96	54	78.1	0.34	
Scipio	94	36	67.4	0.43	
Snowville	98	39	69.6	0.04	
Strawberry Valley				1.08	
Sunnyside				0.64	
Tooele	97	53	83.2	0.11	
Tropic	92	37	66.4	0.83	
Trout Creek	99	42	71.2	0.00	
Utah Lake	97	38	70.2	0.27	
Vernal	95	48	72.6	0.52	
Wellington	99	36	69.6	0.00	
Woodruff	89[b]	34[c]	60.8[f]	0.85	
Vermont.					
Burlington	91	55	70.0	7.67	
Cavendish	91	43	69.2	5.98	
Chelsea	86	43	66.2	4.57	
Cornwall	92	48	72.0	4.06	
Enosburg Falls	89	43	68.6	7.59	
Jacksonville	89	40	67.3	3.29	
Manchester	85	44	67.8	4.73	
Norwich	89	41	68.2	7.02	
St. Johnsbury	92	43	69.6	4.35	
Wells	88	48	68.6	5.09	
Westfield				10.92	
Woodstock	88	43	65.5	6.77	
Virginia.					
Arvonia	97	56	78.1	5.79	
Ashland	95	62	78.1	5.30	
Barboursville	93	59	75.0	7.04	
Bigstone Gap	89	54	73.9	3.53	
Blacksburg	90	34	70.5	12.49	
Buchanan				14.13	
Buckingham				5.90	
Burkes Garden	85	45	67.4	9.05	
Callaville	95	60	78.2	5.84	
Charlottesville	94	61	75.4	10.14	
Clarksville				6.85	
Columbia	92	60	76.0	4.00	
Dale Enterprise	95	50	72.6	7.95	
Danville				7.56	
Dinwiddie	95	57	77.0	7.06	
Elk Knob	88	56	72.2	5.22	
Farmville	96	63	79.0	1.75	
Fredericksburg	94	60	76.3	11.69	
Grahams Forge	89	51	70.8	8.05	
Greenwich	93	59	75.6	5.16	
Hampton	95	67	79.6	9.26	
Hot Springs	86	50	69.2	5.84	
Ivanhoe				9.94	
Lexington	93	52	74.3	6.75	
Lincoln	96	52	75.0	4.76	
Marion	92	52	71.8	9.55	
Mendota				6.93	
Newport News	95	66	79.7	8.94	
Petersburg		64		3.19	
Quantico	95	59	76.9	8.40	
Radford				5.22	
Randolph				7.05	
Riverton				4.21	
Roanoke	95	55	78.0	10.78	
Rockymount	96	52	76.5	9.26	
Saxe	96	57	77.2	7.34	
Shenandoah				4.81	
Spottsville	95	59	77.2	7.45	
Stanardsville	93	57	74.8	8.70	
Staunton	91	53	74.0	5.93	
Stephens City	95	52	74.6	5.83	
Warsaw	97	60	77.4	4.29	
Williamsburg	97	61	76.6	8.61	
Woodstock	98	52	75.4	4.62	
Washington.					
Aberdeen	93	45	69.3	0.45	
Anacortes	81	45	61.0	0.33	
Ashford				0.98	
Bellingham	80	45	61.8	0.14	
Blaine	83	45	62.0	0.37	
Bremerton	90[c]	41[c]	63.0[c]	0.53	
Brinnon	87	49	65.0	0.36	
Cedonia	96	35	65.4	0.27	
Centralia	95	40	64.0	0.59	
Cheney	103	38	71.0	0.11	
Clearbrook	96	39	63.3	0.29	
Clearwater	98	42	69.4	0.41	
Cle Elum	104	39	65.6	0.08	
Colfax	103	34	66.8	0.12	
Colville	103	35	65.8	1.39	
Conconully	97	38	67.2	1.01	
Coupeville	88	47	62.2	0.38	
Crescent	104	39	67.8	0.35	
Cusick	102	33	65.0	0.48	
Danville	102	42	69.4	1.01	
Dayton	103	45	72.2	0.07	
East Sound	86	42	61.2	0.31	
Ellensburg	100	42	67.3	0.15	
Ephrata	109	49	77.4	0.00	
Fort Simcoe				T.	
Granite Falls				1.15	
Hatton	112	40	74.2	T.	
Horse Heaven				0.00	
Ilwaco	96	49	60.0	0.66	
Kinnewick	110	48	78.2	0.00	
Kiona	110	49	76.9	T.	
Lacenter	99	45	66.0	0.50	
Lakeside	100	52	74.4	0.20	
Lester	95	39	64.2	0.49	
Lind	108	45	74.4	0.02	
Loomis	103	49	73.7	0.30	
Merritt				0.27	
Mottinger Ranch	114	52	80.2	0.00	
Mount Pleasant	94	46	66.3	0.34	
Moxee	107	39	71.8	T.	
Northport	100	35	65.4	1.00	
Olga	80	44	59.6	0.56	
Olympia	96	42	66.5	0.66	
Pinehill	102	47	72.7	T.	
Pomeroy	110	44	70.8	T.	
Port Townsend	81	48	60.6	0.60	
Pullman	104[d]	42[c]	70.4[c]	0.02	
Rattlesnake	100	42	71.1	0.12	
Republic	102	38	65.8	0.58	
Rosalia	100	36	67.6	0.19	
Sedro	87	49	63.6	1.54	
Silvana[1]	89	44	62.6	1.35	
Snohomish	87	45	62.7	1.54	
Snoqualmie	98	43	65.6	0.60	
Southbend	103	45	62.8	0.17	
South Ellensburg	100	46	70.7	0.02	
Sprague				0.50	
Sunnyside	104	44	72.5	T.	
Tekoa				0.00	
Touchet	113	48	78.9	T.	
Trinidad	109	55	79.7	0.00	
Twisp	103	43	69.8	0.77	
Union	98	44	65.2	0.22	
Vancouver	100	48	68.5	0.24	
Vashon	86	50	64.0	0.36	
Wahluke	110	50	78.0	0.00	
Waterville	100	41	68.6	0.19	
Wenatchee (near)	101	41	71.2	0.02	
Wilbur	100	34	65.2	0.23	
Zindel	112	52	82.6	T.	
West Virginia.					
Bancroft	96	55	76.2	5.79	
Bayard	87	43	68.0	7.38	
Bens Run	96	56	76.0	5.68	
Berkley Springs	95	57	74.8	7.56	
Bluefield	90	51	72.7	6.10	
Buckhannon	94	49	93.6	7.37	
Burlington	91	50	72.5	10.64	
Cairo	93	50	73.7	3.28	
Central	93	50	73.1	3.56	
Charleston	92	58	76.8	4.56	
Creston	94[c]	52[c]	74.0[c]	4.35	
Cuba	91	52	73.4	4.52	
Elkhorn	91	51	72.2	9.56	
Fairmont	94	51	74.2	8.70	
Glenville	96	53	75.8	3.92	
Grafton	91	49	73.1	7.92	
Green Sulphur Springs	91	50	70.8	6.49	
Harpers Ferry				5.46	
Hinton				5.91	
Huntington	95	50	76.0	4.78	
Leonard	86	50	71.2	7.73	
Lewisburg	91	48	71.8	6.89	
Logan	92	56	74.0	3.27	
Lost Creek	91	48	71.8	4.14	
Madison	94	54	75.5	6.81	
Marlinton	87	49	69.7	8.25	
Martinsburg	96	55	75.4	9.30	
Moorefield	98	48	74.6	5.67	
Morgantown	94	54	73.3	5.36	
Moundsville	97	51	73.6	3.39	
New Cumberland	91	53	71.8	4.10	
New Martinsville	97	53	76.3	3.20	
Nuttallburg	90	50	69.8	3.00	
Parsons	89	50	70.6	5.66	
Philippi	95	46	72.7	8.56	
Pickens	94	48	70.0	6.48	
Point Pleasant	95	55	76.6	6.19	
Princeton	83	59	71.2	10.55	
Romney	98	51	73.0	7.20	
Rowlesburg				7.68	
Ryan	94	52	74.0	4.69	

TABLE II.—*Climatological record of cooperative observers. Late reports for June*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
West Virginia—Cont'd.	°	°	°	*Ins.*	*Ins.*
Smithfield	96	54	77.4	5.50	
Southside	96	52	75.6	4.96	
Sutton	97	52	77.0	5.34	
Terra Alta	88	49	71.1	7.33	
Uppertract	93	52	72.6	5.91	
Valley Fork	96	52	74.4	6.93	
Wellsburg	89	53	72.0	4.85	
Weston	.....	.....	.....	5.84	
Wheeling	102	58	77.0	3.23	
Wisconsin.					
Amherst	93	44	68.3	4.82	
Antigo	95	42	66.6	.....	
Appleton	94	50	68.9	6.23	
Appleton Marsh	94	42	67.8	4.69	
Ashland	.....	.....	.....	2.47	
Barron	96	44	69.0	3.50	
Berlin	95	51	69.6	3.97	
Black River Falls	.....	.....	.....	4.80	
Burnett	93	49	68.6	2.71	
Butternut	93	40	66.6	4.88	
Chilton	93	47	68.4	4.04	
Chippewa Falls	.....	.....	.....	1.85	
Citypoint	94	52	69.2[c]	3.08	
Cranberry Ex. Sta.	95	35	65.4	3.07	
Darlington	100	42	69.6	2.78	
Dodgeville	96	47	70.8	.....	
Downing	95	40	65.8	2.65	
Eau Claire	98	49	70.4	2.46	
Florence	93	39	63.6	4.55	
Fond du Lac	95	44	68.0	2.19	
Grand Rapids	92	48	68.2	2.21	
Grand River Locks	.....	.....	.....	5.43	
Grantsburg	93	43	67.6	5.53	
Hancock	95	48	68.8	4.10	
Hayward	92	39	65.4	4.91	
Hillsboro	95	44	68.8	3.75	
Koepenick	96	38	67.4	3.50	
Lancaster	94	49	69.4	3.32	
Manitowoc	94	51	66.0	3.46	
Mauston	92	48	68.2	3.90	
Meadow Valley	95	43	68.6	3.12	
Medford	95	43	68.6	6.50	
Menasha	.....	.....	.....	4.04	
Minocqua	92	50	66.2	2.43	
Mount Horeb	95	52	69.9	2.49	
Neillsville	96	44	69.4	3.18	
New London	96	46	69.0	5.27	
New Richmond	94	46	68.6	2.25	
Oconto	96	48	67.2	5.03	
Osceola	95	44	68.0	2.65	
Oshkosh	93[d]	50[d]	68.6[d]	4.30	
Pine River	95	48	68.3	5.63	
Portage	93	50	69.8	2.78	
Port Washington	93	46	63.6	3.20	
Prairie du Chien	98	52	71.8	1.45	
Prentice	92	38	66.5	3.94	
Racine	96	45	68.0	3.45	
Sheboygan	97[b]	51[b]	67.0[b]	3.75	
Spooner	96	42	68.2	4.11	
Stanley	92	43	67.0	2.84	
Stevens Point	93	43	67.4	3.85	
Sturgeon Bay Canal	94	42	64.4	8.90	
Valley Junction	93	43	69.4	4.33	
Viroqua	93	50	69.6	3.22	
Watertown	94	49	69.2	3.46	
Waukesha	91	49	67.6	2.77	
Waupaca	95	47	69.6	4.37	
Whitehall	92	45	66.6	2.68	
Wyoming.					
Afton	87	34	58.8	0.91	
Alcova	94	44	67.8	1.71	
Basin	102	49	73.6	0.18	
Bedford	86	29	59.6	0.78	
Border	91	29	62.2	0.37	
Buffalo	83	39	63.4	1.10	
Cambria	92	44	67.2	4.30	
Chugwater	88	39	63.4	2.23	
Clark	.....	.....	.....	1.92	
Daniel	81	30	54.2	0.63	
Dubois	.....	.....	.....	0.14	
Elk Mountain	.....	.....	.....	2.63	
Evanston	87	35	61.0	0.84	
Fayette	89	33	62.4	1.40	
Fort Laramie	95	44	68.4	3.19	
Fort Washakie	96	33	62.6	1.76	
Gillette	93	48	68.8	3.04	
Granite Canyon	83	34	58.6	1.79	
Granite Springs	.....	.....	.....	2.13	
Green River	95	37	68.0	0.37	
Griggs	92	41	65.2	2.03	
Hatton	.....	.....	.....	1.94	
Hyattville	96	40	69.6	.....	
Iron Mountain	87	38	62.3	2.93	
Jackson	88	27	58.7	1.20	
Kirtley	88	39	63.9	2.84	
Laramie	91	33	61.4	1.79	
Leo	87	35	61.5	0.49	
Wyoming—Cont'd.	°	°	•	*Ins.*	*Ins.*
Little Medicine	82	32	58.1	2.03	
Lolabama Ranch	82	32	55.4	2.89	
Lusk	89	39	64.0	3.01	
Marquette	89	39	63.0	1.11	
Meeteetse	95	41	64.4	0.81	
Moore	88	39	63.0	1.35	
Moorcroft	95	44	68.0	3.65	
Phillips	90	40	64.0	2.68	
Pine Bluff	96	41	65.8	5.21	
Rambler	74	31	53.4	1.37	
Rock Springs	92	37	66.8	.....	
Sheridan	87	40	64.8	1.30	
South Pass City	89	29	59.0	2.55	
Story	85	46	65.2	2.38	
Thayne	88	28	59.4	0.96	
Wells	80	29	55.6	1.09	
Yellowstone Pk. (C. H.)	79	29	59.5	0.78	
Yellowstone Pk. (Foun'n)	81	28	55.0	0.88	
Yellowstone Pk. (Lake)	86	28	55.0	1.01	
Yellowstone Pk. (Norris)	93	27	56.8	1.17	
Yellowstone Pk (Riversde)	84	28	55.9	1.05	
Yellowstone Pk. (Soda B.)	87	28	56.4	1.75	
Yellowstone Pk (Snake R)	87	29	56.6	1.28	
Yellowstone Pk. (Thumb)	90	29	55.4	0.29	
Yellowstone Pk. (U. Ba'n)	91	27	57.9	1.28	
Porto Rico.					
Adjuntas	89	53	71.2	6.53	
Aguirre	96	73	81.2	7.98	
Aibonito	88	62	76.0	5.79	
Barros	91	61	76.0	4.12	
Bayamon	91	65	78.2	8.43	
Caguas	95	64	78.7	7.91	
Canovanas	90	73	80.9	6.33	
Cidra	90	60	75.6	3.83	
Coamo	92	65	80.2	2.37	
Coloso	93	66	80.3	6.15	
Carozal	90	60	78.0	5.33	
Fajardo	93	72	82.9	3.44	
Hacienda Josefa	.....	.....	.....	7.74	
Humacao	91	76	83.7	6.65	
Ingenio	.....	.....	.....	7.80	
Isabela	90	70	79.8	1.63	
Juana Diaz	96	69	82.6	3.55	
La Carmelita	89	64	76.0	6.36	
La Ysolina	93	63	77.8	3.65	
Lares	92	60	77.0	4.01	
Las Cruces	89	62	73.2	6.02	
Las Marias	93	63	77.6	7.44	
Manati	97	68	81.0	3.48	
Maunabo	94	72	82.7	5.34	
Mayaguez	95	60	79.8	7.64	
Rio Blanco	89	65	78.8	11.50	
Rio Piedras	.....	.....	.....	9.03	
San German	96	60	78.7	2.39	
San Lorenzo	94	65	79.2	12.91	
San Salvador	90	63	75.6	2.03	
Santa Isabel	91	66	79.6	5.10	
Vega Baja	95	69	82.0	12.72	
Vieques	93	74	82.6	3.21	
New Brunswick.					
St. John	78	51	60.0	2.77	
West Indies.					
Basseterre, St. Kitts	88	70	81.0	3.43	
Port of Spain	88	68	77.6	8.87	
Roseau	91	73	82.0	5.60	
Oregon.	°	°	°	*Ins.*	*Ins.*
Tipton	.....	.....	.....	0.53	
South Dakota.					
De Smet	91	40	63.6	8.21	
Mexico.					
Coatzacoalcos	89	66	77.3	13.75	
Vera Cruz	89	70	81.0	10.97	

Late reports for June, 1905.

Stations.	°	°	°	*Ins.*	*Ins.*
Alaska.					
Kenai	69	28	49.6	0.84	
Petersburg	80	39	57.8	1.95	
Rampart	.....	.....	.....	1.33	
Tyoonok	67	37	52.1	1.27	
Arkansas.					
Newport	101	53	79.8	.....	
Georgia.					
Carrollton	94	54	75.8	3.98	
Iowa.					
Fayette	91	42	67.2	5.15	
Monticello	96	44	70.7	3.80	
Maine.					
Greenville	.....	.....	.....	3.99	
Patten	92	26	58.8	5.25	
Minnesota.					
Halstead	84	39	60.1	4.41	
Mississippi.					
Okolona	101	58	80.2	.....	
Ripley	95	51	75.8	.....	
Montana.					
Chinook	90[d]	35[d]	60.1[d]	3.50	
Nebraska.					
Holbrook	.....	.....	.....	7.40	
North Carolina.					
Brewers	94	44	73.2	3.72	
Marshall	94	48	74.7	6.16	

EXPLANATION OF SIGNS.

* Extremes of temperature from observed readings of dry thermometer.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. ÷ 4.
[2] Mean of 8 a. m. + 8 p. m. ÷ 2.
[3] Mean of 7 a. m. + 7 p. m. ÷ 2.
[4] Mean of 6 a. m. + 6 p. m. ÷ 2.
[5] Mean of 7 a. m. + 2 p. m. + 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance, "[a]" denotes 14 days missing.

No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks of whatever duration, in the precipitation record receive appropriate notice.

CORRECTIONS, JUNE, 1905.

Iowa, Amana, make total precipitation 7.52 instead of 7.62. Montana, Fort Harrison, make mean temperature 56.6 instead of 56.4. North Dakota, Willow City, make precipitation 5.85 instead of 5.58.

TABLE III.—*Resultant winds from observations at 8 a. m. and 8 p. m., daily, during the month of July, 1905.*

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
New England.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Eastport, Me	10	34	8	22	s. 30 w.	28
Portland, Me	12	33	11	17	s. 16 w.	22
Concord, N. H. †	8	10	9	12	s. 56 w.	4
Northfield, Vt	13	38	7	11	s. 9 w.	25
Boston, Mass	11	18	13	31	s. 69 w.	19
Nantucket, Mass	9	31	10	29	s. 41 w.	29
Block Island, R. I	10	27	14	28	s. 39 w.	22
Providence, R. I	14	22	9	31	s. 70 w.	23
Hartford, Conn	17	33	8	16	s. 27 w.	18
New Haven, Conn	13	25	15	22	s. 30 w.	14
Middle Atlantic States.						
Albany, N. Y	14	35	11	12	s. 3 w.	21
Binghamton, N. Y. †	9	10	12	9	s. 72 e.	3
New York, N. Y	11	26	13	23	s. 34 w.	18
Harrisburg, Pa	11	22	16	25	s. 39 w.	14
Philadelphia, Pa	12	30	12	24	s. 34 w.	22
Scranton, Pa	10	35	4	27	s. 43 w.	34
Atlantic City, N. J	11	31	13	27	s. 35 w.	24
Cape May, N. J	11	30	17	19	s. 6 w.	19
Baltimore, Md	18	21	12	29	s. 80 w.	17
Washington, D. C	14	32	12	16	s. 13 w.	18
Lynchburg, Va	11	24	14	26	s. 43 w.	18
Mount Weather, Va	14	25	13	23	s. 42 w.	15
Norfolk, Va	4	42	16	12	s. 6 e.	38
Richmond, Va	13	33	17	13	s. 11 e.	20
Wytheville, Va	11	16	19	29	s. 63 w.	11
South Atlantic States.						
Asheville, N. C	20	24	22	13	s. 66 e.	10
Charlotte, N. C	10	29	16	20	s. 12 w.	19
Hatteras, N. C	4	36	9	31	s. 34 w.	39
Raleigh, N. C	10	30	12	21	s. 24 w.	22
Wilmington, N. C	6	36	11	23	s. 22 w.	32
Charleston, S. C	4	39	12	18	s. 10 w.	36
Columbia, S. C	8	33	9	25	s. 33 w.	30
Augusta, Ga	8	33	24	18	s. 13 e.	26
Savannah, Ga	8	26	6	32	s. 55 w.	32
Jacksonville, Fla	4	35	16	23	s. 13 w.	32
Florida Peninsula.						
Jupiter, Fla	6	31	14	25	s. 24 w.	27
Key West, Fla	11	17	33	11	s. 75 e.	23
Tampa, Fla	13	16	33	10	s. 83 e.	23
Eastern Gulf States.						
Atlanta, Ga	10	21	19	28	s. 42 w.	14
Macon, Ga. †	7	14	5	12	s. 45 w.	10
Pensacola, Fla. †	9	8	3	21	n. 87 w.	18
Birmingham, Ala. †	6	12	7	15	s. 53 w.	10
Mobile, Ala	13	25	5	28	s. 62 w.	26
Montgomery, Ala	13	21	11	27	s. 63 w.	18
Meridian, Miss. †	5	13	4	16	s. 56 w.	14
Vicksburg, Miss	7	35	13	22	s. 18 w.	29
New Orleans, La	9	27	9	32	s. 52 w.	29
Western Gulf States.						
Shreveport, La	7	39	13	16	s. 5 w.	32
Fort Smith, Ark	12	18	26	15	s. 61 e.	12
Little Rock, Ark	14	28	15	18	s. 12 w.	14
Corpus Christi, Tex	3	46	27	2	s. 30 e.	30
Fort Worth, Tex	7	36	22	12	s. 19 e.	31
Galveston, Tex	6	44	8	16	s. 11 w.	39
Palestine, Tex	10	38	13	14	s. 2 w.	28
San Antonio, Tex	6	29	42	1	s. 61 e.	47
Taylor, Tex. †	2	22	6	9	s. 9 w.	20
Ohio Valley and Tennessee.						
Chattanooga, Tenn	11	28	11	28	s. 45 w.	24
Knoxville, Tenn	17	28	11	25	s. 67 w.	15
Memphis, Tenn	9	34	12	21	s. 20 w.	27
Nashville, Tenn	11	20	13	34	s. 67 w.	23
Lexington, Ky. †	4	17	6	10	s. 17 w.	14
Louisville, Ky	11	33	7	23	s. 36 w.	27
Evansville, Ind. †	6	17	4	8	s. 20 w.	12
Indianapolis, Ind	13	31	7	22	s. 40 w.	28
Cincinnati, Ohio	13	27	17	26	s. 33 w.	17
Columbus, Ohio	14	31	11	22	s. 33 w.	20
Pittsburg, Pa	18	25	6	28	s. 72 w.	23
Parkersburg, W. Va	11	36	6	19	s. 27 w.	28
Elkins, W. Va	13	28	4	25	s. 55 w.	26
Lower Lake Region.						
Buffalo, N. Y	12	27	16	23	s. 25 w.	17
Oswego, N. Y	9	32	77	21	s. 36 w.	29
Rochester, N. Y	13	24	10	28	s. 59 w.	21
Syracuse, N. Y	9	34	8	19	s. 24 w.	27
Erie, Pa	12	30	10	23	s. 36 w.	22
Cleveland, Ohio	18	28	19	15	s. 22 e.	11
Sandusky, Ohio †	4	13	3	16	s. 55 w.	16
Toledo, Ohio	15	22	15	23	s. 49 w.	11
Detroit, Mich	17	16	13	26	n. 86 w.	13
Upper Lake Region.						
Alpena, Mich	18	20	15	23	s. 76 w.	8
Escanaba, Mich	25	20	17	13	n. 39 e.	6
Grand Rapids, Mich	11	24	17	17	s.	13
Houghton, Mich. †	5	5	14	13	e.	1
Marquette, Mich	21	20	12	19	n. 82 w.	7
Port Huron, Mich	19	22	15	18	s. 45 w.	4
Sault Ste. Marie, Mich	18	13	19	27	n. 58 w.	9
Chicago, Ill	25	19	14	18	n. 34 w.	7
Milwaukee, Wis	28	12	14	22	n. 27 w.	18
Green Bay, Wis	18	19	21	18	s. 72 e.	3
Duluth, Minn	36	4	22	21	n. 2 e.	32

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
North Dakota.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Moorhead, Minn	27	18	15	14	n. 6 e.	9
Bismarck, N. Dak	27	10	23	16	n. 22 e.	18
Devils Lake, N. Dak	25	14	15	18	n. 15 w.	11
Williston, N. Dak	23	15	27	12	n. 62 e.	17
Upper Mississippi Valley.						
Minneapolis, Minn. *	15	8	4	10	n. 41 w.	9
St. Paul, Minn	28	17	12	15	n. 15 w.	11
La Crosse, Wis. †	16	10	4	5	n. 9 w.	6
Madison, Wis	23	20	15	19	n. 53 w.	5
Charles City, Iowa	26	17	15	19	n. 24 w.	10
Davenport, Iowa	18	13	19	26	n. 54 w.	9
Des Moines, Iowa	22	18	14	23	n. 66 w.	10
Dubuque, Iowa	23	21	12	17	n. 68 w.	5
Keokuk, Iowa	23	22	9	26	n. 87 w.	17
Cairo, Ill	10	29	16	23	s. 20 w.	20
La Salle, Ill. †	10	9	8	12	n. 76 w.	4
Peoria, Ill	10	12	6	11	s. 68 w.	5
Springfield, Ill	15	26	13	24	s. 45 w.	16
Hannibal, Mo. †	6	13	4	16	s. 60 w.	14
St. Louis, Mo	12	30	13	24	s. 31 w.	21
Missouri Valley.						
Columbia, Mo. *	12	13	3	9	s. 80 w.	6
Kansas City, Mo	25	20	17	15	n. 22 e.	5
Springfield, Mo	15	30	17	16	s. 4 e.	15
Topeka, Kans. *	9	5	13	6	n. 60 e.	8
Lincoln, Nebr	21	22	16	13	s. 72 e.	3
Omaha, Nebr	25	20	16	11	n. 45 e.	7
Valentine, Nebr	21	16	25	13	n. 67 e.	13
Sioux City, Iowa †	12	7	10	9	n. 11 e.	5
Pierre, S. Dak	15	24	29	15	s. 57 e.	17
Huron, S. Dak	25	16	21	14	n. 38 e.	11
Yankton, S. Dak. †	11	8	11	9	n. 34 e.	4
Northern Slope.						
Havre, Mont	15	10	29	20	n. 61 e.	10
Miles City, Mont	28	12	19	13	n. 21 e.	17
Helena, Mont	16	21	7	33	s. 79 w.	26
Kalispell, Mont	16	16	5	37	w.	32
Rapid City, S. Dak	17	19	18	22	s. 63 w.	4
Cheyenne, Wyo	26	16	15	22	n. 35 w.	12
Lander, Wyo	21	15	9	32	n. 75 w.	24
Yellowstone Park, Wyo	17	28	3	31	s. 68 w.	30
North Platte, Nebr	13	27	20	14	s. 23 e.	15
Middle Slope.						
Denver, Colo	22	30	9	12	s. 21 w.	8
Pueblo, Colo	22	15	21	20	n. 8 e.	7
Concordia, Kans	14	18	25	16	s. 66 e.	10
Dodge, Kans	13	22	28	7	s. 67 e.	23
Wichita, Kans	23	22	21	10	n. 85 e.	11
Oklahoma, Okla	14	26	20	15	s. 23 e.	13
Southern Slope.						
Abilene, Tex	13	37	13	9	s. 9 e.	24
Amarillo, Tex	11	33	27	10	s. 38 e.	28
Roswell, N. Mex.	18	23	18	18	s.	5
Southern Plateau.						
El Paso, Tex	23	8	33	15	n. 50 e.	23
Santa Fe, N. Mex	17	17	34	13	e.	21
Flagstaff Ariz	32	13	8	24	n. 40 w.	25
Phoenix, Ariz	14	8	26	24	n. 18 e.	6
Yuma, Ariz	2	33	15	23	s. 14 w.	32
Independence, Cal	22	17	17	25	n. 58 w.	9
Middle Plateau.						
Carson City, Nev	5	27	6	41	s. 58 w.	41
Winnemucca, Nev	22	20	14	25	n. 80 w.	11
Modena, Utah	4	15	8	45	s. 74 w.	39
Salt Lake City, Utah	19	27	19	13	s. 37 e.	10
Durango, Colo	28	5	5	39	n. 56 w.	41
Grand Junction, Colo	17	12	24	24	n.	5
Northern Plateau.						
Baker City, Oreg	26	23	10	20	n. 73 w.	10
Boise, Idaho	16	18	20	25	s. 68 w.	5
Lewiston, Idaho †	1	2	29	2	s. 88 e.	27
Pocatello, Idaho	5	20	23	23	s.	15
Spokane, Wash	17	17	21	18	e.	3
Walla Walla, Wash	4	33	7	27	s. 35 w.	35
North Pacific Coast Region.						
North Head, Wash	34	10	2	33	n. 52 w.	39
Port Crescent, Wash. *	6	2	3	25	n. 80 w.	22
Seattle, Wash	23	17	12	24	n. 63 w.	13
Tacoma, Wash	26	11	2	30	n. 62 w.	32
Tatoosh Island, Wash	5	31	3	37	s. 52 w.	43
Portland, Oreg	33	10	8	26	n. 36 w.	31
Roseburg, Oreg	41	1	16	13	n. 4 e.	40
Middle Pacific Coast Region.						
Eureka, Cal	29	13	3	30	n. 59 w.	31
Mount Tamalpais, Cal	24	1	1	48	n. 64 w.	52
Red Bluff, Cal	17	37	3	15	s. 31 w.	23
Sacramento, Cal	5	46	15	7	s. 11 e.	42
San Francisco, Cal	1	16	3	53	s. 73 w.	52
South Pacific Coast Region.						
Fresno, Cal	43	0	0	40	n. 43 w.	59
Los Angeles, Cal	3	23	8	39	s. 57 w.	37
San Diego, Cal	14	18	4	41	s. 84 w.	37
San Luis Obispo, Cal	23	12	2	36	n. 72 w.	36
West Indies						
Grand Turk, W. I	1	6	28	0	s. 80 e.	28
Hamilton, Bermuda	10	20	11	34	s. 67 w.	25
Havana, Cuba †	1	4	29	0	s. 84 e.	29
San Juan, Porto Rico	2	7	55	2	s. 85 e.	53

* From observations at 8 p. m. only. † From observations at 8 a. m. only.

TABLE IV.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.75 in 1 hour during July, 1905, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Albany, N. Y	10			0.65														0.38			
Alpena, Mich	4	1:42 p. m.	2:45 p. m.	0.79	1:46 p. m.	2:06 p. m.	0.01	0.29	0.45	0.56	0.77										
Do	19	12:10 a. m.	12:40 a. m.	0.53	12:10 a. m.	12:22 a. m.	0.00	0.29	0.46	0.51											
Amarillo, Tex	21	1:30 p. m.	2:40 p. m.	0.74	1:58 p. m.	2:19 p. m.	0.04	0.28	0.50	0.55	0.62	0.68									
Asheville, N. C	1	2:45 p. m.	5:20 p. m.	1.59	2:50 p. m.	3:20 p. m.	0.01	0.40	0.80	0.96	1.07	1.17									
Atlanta, Ga	6	6:08 p. m.	7:10 p. m.	0.81	6:14 p. m.	6:38 p. m.	0.01	0.22	0.59	0.66	0.72	0.78									
Do	10	2:00 p. m.	7:20 p. m.	1.29	2:04 p. m.	2:59 p. m.	0.02	0.15	0.24	0.25	0.26	0.27	0.37	0.51	0.60	0.70	0.78	0.81			
Atlantic City, N. J	24			0.52														0.34			
Augusta, Ga	4			0.64						0.48											
Baltimore, Md	7	11:05 a. m.	1:25 p. m.	2.57	11:09 a. m.	11:50 a. m.	0.01	0.07	0.13	0.20	0.50	0.99	1.23	1.32	1.41						
					12:23 p. m.	12:48 p. m.	1.61	0.12	0.31	0.53	0.75	0.93									
Do	23–24	11:35 p. m.	2:15 a. m.	0.89	11:53 p. m.	12:30 a. m.	0.02	0.17	0.35	0.48	0.58	0.61	0.66	0.74							
Binghamton, N. Y	2	1:15 p. m.	3:55 p. m.	2.42	1:38 p. m.	2:48 p. m.	0.10	0.17	0.54	0.77	1.04	1.31	1.39	1.48	1.61	1.77	1.92	2.14	2.29		
Birmingham, Ala	24	10:23 a. m.	2:15 p. m.	1.15	11:20 a. m.	12:05 p. m.	0.22	0.06	0.15	0.38	0.50	0.54	0.63	0.69	0.77	0.84					
Bismarck, N. Dak	29			0.36									0.34								
Block Island, R. I	24	9:10 p. m.	11:10 p. m.	0.98	9:37 p. m.	10:36 p. m.	0.01	0.12	0.15	0.21	0.23	0.27	0.39	0.47	0.59	0.74	0.79	0.96			
Boise, Idaho	24			0.01																	
Boston, Mass	14			0.55				0.21													
Buffalo, N. Y	12			0.66							0.49										
Cairo, Ill	10	9:35 a. m.	1:55 p. m.	0.94	12:39 p. m.	1:09 p. m.	0.09	0.08	0.22	0.40	0.58	0.68	0.78								
Charles City, Iowa	3			0.74														0.20			
Charleston, S. C	24–25	10:45 p. m.	D. N.	0.87	11:05 p. m.	11:40 p. m.	0.01	0.08	0.17	0.44	0.51	0.59	0.72	0.77							
Charlotte, N. C	6	7:35 p. m.	9:30 p. m.	0.84	7:51 p. m.	8:17 p. m.	T.	0.08	0.30	0.52	0.67	0.74									
Chattanooga, Tenn	10–11			1.13														0.57			
Chicago, Ill	28	4:05 a. m.	8:28 a. m.	1.81	5:19 a. m.	5:35 a. m.	0.05	0.23	0.37	0.50											
					6:19 a. m.	6:44 a. m.	0.62	0.05	0.10	0.19	0.30	0.47									
					7:40 a. m.	8:04 a. m.	1.28	0.06	0.19	0.40	0.47	0.53									
Cincinnati, Ohio	23			0.32														0.27			
Cleveland, Ohio	12	3:35 p. m.	4:35 p. m.	0.75	3:37 p. m.	3:58 p. m.	0.02	0.05	0.18	0.37	0.72	0.77									
Columbia, Mo	2–3	7:09 p. m.	1:25 a. m.	1.38	9:10 p. m.	9:20 p. m.	0.32	0.36	0.96	1.00	1.03										
Columbia, S. C	4	3:03 p. m.	4:06 p. m.	0.77	3:03 p. m.	3:23 p. m.	0.00	0.12	0.50	0.63	0.75										
Do	26	10:35 a. m.	11:06 a. m.	0.77	10:35 a. m.	10:55 a. m.	0.00	0.14	0.52	0.61	0.75										
Do	28–29	9:00 p. m.	D. N.	1.66	10:46 p. m.	11:16 p. m.	0.19	0.05	0.12	0.43	0.75	0.98	1.07								
Columbus, Ohio	6			0.43														0.40			
Concord, N. H	17			0.62														0.44			
Corpus Christi, Tex	18	8:34 a. m.	1:12 p. m.	1.02	8:53 a. m.	9:23 a. m.	0.01	0.16	0.37	0.59	0.68	0.83	0.89								
Davenport, Iowa	6			0.41							0.33										
Denver, Colo	8			0.82														0.31			
Des Moines, Iowa	19	5:20 a. m.	9:40 a. m.	2.38	5:28 a. m.	6:52 a. m.	0.01	0.16	0.65	1.02	1.13	1.14	1.14	1.14	1.14	1.15	1.23	1.30	1.68	1.80	
Detroit, Mich	14	12:43 p. m.	1:44 p. m.	0.80	1:05 p. m.	1:20 p. m.	0.09	0.47	0.57	0.67											
Dodge, Kans	29–30	4:20 p. m.	D. N.	2.73	5:40 p. m.	6:15 p. m.	0.43	0.06	0.12	0.23	0.46	0.66	0.86	0.97							
Dubuque, Iowa	5			0.34						0.30											
Duluth, Minn	3			1.95														0.63			
Eastport, Me	26			0.39						0.37											
Elkins, W. Va	7	3:45 p. m.	4:20 p. m.	0.55	3:56 p. m.	4:08 p. m.	T.	0.19	0.48	0.53								0.55			
Erie, Pa	11	12:20 p. m.	1:35 p. m.	0.86	12:58 p. m.	1:26 p. m.	0.01	0.11	0.28	0.54	0.70	0.76	0.84								
Escanaba, Mich	3			0.96														0.65			
Evansville, Ind	10–11	3:46 p. m.	1:20 a. m.	2.32	6:11 p. m.	6:41 p. m.	0.24	0.06	0.11	0.27	0.62	0.77	1.14								
Fort Smith, Ark	5	8:57 a. m.	11:35 a. m.	0.94	10:00 a. m.	10:18 a. m.	0.16	0.21	0.44	0.63	0.68										
Fort Worth, Tex	2	10:32 p. m.	11:30 p. m.	1.55	10:32 p. m.	11:19 p. m.	0.00	0.25	0.62	0.99	1.07	1.18	1.22	1.23	1.30	1.48	1.55				
Do	3	10:20 a. m.	1:55 p. m.	0.86	1:06 p. m.	1:19 p. m.	T.	0.31	0.55	0.70											
Do	8	7:26 a. m.	12:25 p. m.	2.10	7:38 a. m.	9:38 a. m.	0.01	0.08	0.19	0.23	0.32	0.36	0.47	0.57	0.60	0.62	0.63	0.85	1.09	1.50	1.69
Galveston, Tex	9			1.16					0.47												
Grand Rapids, Mich	29	12:35 a. m.	2:15 a. m.	1.19	12:58 a. m.	1:21 a. m.	0.10	0.32	0.71	0.81	0.87	0.92									
Green Bay, Wis	6			0.80						0.72											
Hannibal, Mo	2	7:50 p. m.	D. N.	1.76	10:14 p. m.	10:51 p. m.	0.68	0.09	0.13	0.23	0.40	0.52	0.84	0.97	1.01						
Harrisburg, Pa	23	8:36 p. m.	10:15 p. m.	1.02	8:39 p. m.	9:04 p. m.	0.01	0.10	0.20	0.50	0.74	0.91									
Do	29	4:29 p. m.	6:40 p. m.	0.97	4:53 p. m.	5:23 p. m.	0.01	0.10	0.17	0.27	0.44	0.75	0.83								
Hartford, Conn	24	5:40 p. m.	6:55 p. m.	0.78	6:02 p. m.	6:18 p. m.	0.02	0.06	0.50	0.68											
Hatteras, N. C	6	11:40 a. m.	2:00 p. m.	0.93	12:50 p. m.	1:25 p. m.	0.08	0.19	0.22	0.25	0.36	0.43	0.57	0.63							
Huron, S. Dak	6	6:15 p. m.	9:30 p. m.	1.62	6:42 p. m.	7:07 p. m.	0.08	0.29	0.73	1.12	1.31	1.39									
Indianapolis, Ind	2–3			0.40									0.38								
Jacksonville, Fla	5	1:55 p. m.	3:05 p. m.	0.60	2:03 p. m.	2:33 p. m.	T.	0.24	0.37	0.43	0.45	0.52	0.59								
Do	17	9:42 a. m.	11:18 a. m.	1.40	10:37 a. m.	11:12 a. m.	0.28	0.30	0.59	0.84	0.94	1.00	1.04	1.11							
Jupiter, Fla	30	1:28 p. m.	5:20 p. m.	1.83	1:51 p. m.	2:24 p. m.	0.12	0.21	0.56	0.92	1.35	1.50	1.52	1.64							
Kansas City, Mo	2	9:45 a. m.	1:25 p. m.	1.42	10:48 a. m.	11:14 a. m.	0.06	0.15	0.45	0.64	0.87	1.03	1.08								
Do	26	12:30 p. m.	4:30 p. m.	1.57	1:34 p. m.	2:10 p. m.	0.36	0.11	0.33	0.45	0.57	0.74	0.85	0.90	0.96						
Key West, Fla	13	6:53 a. m.	9:35 a. m.	1.05	8:28 a. m.	8:40 a. m.	0.43	0.31	0.55	0.60											
Knoxville, Tenn	24			0.46						0.40											
La Crosse, Wis	5			0.49						0.46											
La Salle, Ill	7			0.43														0.24			
Lexington, Ky	9			0.47							0.43										
Lincoln, Nebr	2			0.97														0.64			
Little Rock, Ark	8			0.61														0.37			
Los Angeles, Cal	†																				
Louisville, Ky	21	12:10 p. m.	5:15 p. m.	1.03	1:18 p. m.	1:36 p. m.	0.24	0.09	0.30	0.45	0.52										
Lynchburg, Va	5	5:50 p. m.	6:50 p. m.	0.93	6:14 p. m.	6:29 p. m.	0.07	0.18	0.52	0.83											
Do	13	10:00 a. m.	11:10 a. m.	0.74	10:18 a. m.	10:41 a. m.	0.02	0.15	0.33	0.54	0.65	0.71									
Macon, Ga	3	12:45 p. m.	2:05 p. m.	0.84	1:00 p. m.	1:10 p. m.	0.02	0.34	0.70												
Madison, Wis	8			0.40					0.35												
Memphis, Tenn	3	D. N.	8:05 a. m.	1.35	2:41 a. m.	3:31 a. m.	0.02	0.11	0.13	0.22	0.27	0.35	0.47	0.57	0.64	0.81	0.95				
Do	30	10:50 a. m.	11:50 a. m.	0.92	10:50 a. m.	11:08 a. m.	0.00	0.20	0.47	0.66	0.73										
Meridian, Miss	10	7:20 a. m.	1:00 p. m.	1.55	11:20 a. m.	11:55 a. m.	0.30	0.19	0.33	0.46	0.54	0.65	0.99	1.08							
Milwaukee, Wis	8			0.67														0.49			
Minneapolis, Minn	5			0.82														0.50			
Montgomery, Ala	10			0.50														0.44			
Mount Weather, Va	19	3:45 p. m.	4:30 p. m.	1.33	3:51 p. m.	4:26 p. m.	0.01	0.08	0.14	0.37	0.81	1.09	1.27	1.32							
Nantucket, Mass	2–3	11:45 p. m.	5:50 a. m.	2.10	11:52 p. m.	12:52 a. m.	0.02	0.09	0.10	0.11	0.14	0.32	0.44	0.64	0.84	0.94	1.05	1.25			
Nashville, Tenn	10	1:08 p. m.	3:20 p. m.	0.69	1:18 p. m.	1:36 p. m.	0.01	0.06	0.23	0.47	0.60										
New Haven, Conn	19			0.34					0.32												
New Orleans, La	10	7:40 a. m.	9:45 a. m.	0.81	8:01 a. m.	8:25 a. m.	0.08	0.15	0.30	0.36	0.44	0.53									
Do	24	12:33 p. m.	2:05 p. m.	0.54	1:28 p. m.	1:43 p. m.	0.01	0.21	0.41	0.50											
New York, N. Y	10	2:48 p. m.	4:29 p. m.	2.56	3:32 p. m.	4:04 p. m.	0.40	0.43	0.95	1.63	1.88	1.99	2.08	2.11							
Do	30	1:45 a. m.	4:15 a. m.	1.05	3:30 a. m.	3:44 a. m.	0.34	0.30	0.60	0.69											
Norfolk, Va	2–3	8:45 p. m.	D. N.	1.60	11:38 p. m.	12:13 a. m.	0.41	0.08	0.19	0.35	0.59	0.70	0.84	1.01							
Do	5	1:32 p. m.	3:50 p. m.	1.95	1:58 p. m.	2:41 p. m.	0.03	0.24	0.48	0.68	1.00	1.35	1.55	1.69	1.79	1.82					
Northfield, Vt	30–31			3.19														0.36			
North Head, Wash	13			0.19														0.13			
Oklahoma, Okla	1			1.33														0.60			
Omaha, Nebr	13	8:30 p. m.	9:55 p. m.	0.74	8:58 p. m.	9:27 p. m.	0.02	0.05	0.16	0.40	0.55	0.68	0.71								
Palestine, Tex	3	6:53 p. m.	D. N.	0.79	6:53 p. m.	7:23 p. m.	0.00	0.09	0.20	0.37	0.54	0.63	0.68								

TABLE IV.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Palestine, Tex	23	1:00 p. m.	1:42 p. m.	0.81	1:00 p. m.	1:15 p. m.	0.00	0.24	0.60	0.71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Parkersburg, W. Va	3-4	9:30 p. m.	D. N.	1.76	9:36 p. m.	10:01 p. m.	0.01	0.13	0.23	0.33	0.49	0.65	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	19	6:29 p. m.	10:00 p. m.	1.05	6:29 p. m.	6:54 p. m.	0.00	0.16	0.49	0.62	0.71	0.76	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pensacola, Fla	10	3:25 p. m.	5:10 p. m.	0.62	4:11 p. m.	4:35 p. m.	0.04	0.18	0.38	0.50	0.51	0.58	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	22	7:05 a. m.	10:05 a. m.	0.87	7:48 a. m.	8:06 a. m.	0.07	0.10	0.45	0.57	0.62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Peoria, Ill	2	6:05 p. m.	7:15 p. m.	1.06	6:14 p. m.	6:39 p. m.	T.	0.31	0.61	0.76	0.96	1.04	.....	.....	.....	.....	.....	.....	.....	.....	.....
Philadelphia, Pa	11	11:09 a. m.	1:17 p. m.	1.28	12:32 p. m.	12:56 p. m.	0.64	0.17	0.27	0.48	0.56	0.63	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pittsburg, Pa	29	D. N.	D. N.	0.67	11:00 p. m.	11:28 p. m.	0.09	0.07	0.16	0.22	0.35	0.54	0.59	.....	.....	.....	.....	.....	.....	.....	.....
Port Huron, Mich	29	6:55 a. m.	9:40 a. m.	1.46	7:57 a. m.	8:30 a. m.	0.07	0.06	0.18	0.43	0.68	0.93	1.21	.....	.....	.....	.....	.....	.....	.....	.....
Portland, Me	30-31	.....	.....	2.18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.27	.....	.....	.....
Portland, Oreg	13	.....	.....	0.11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.09	.....	.....	.....
Providence, R. I	14-15	10:05 p. m.	D. N.	0.80	10:18 p. m.	10:38 p. m.	0.01	0.07	0.42	0.59	0.71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pueblo, Colo	28	5:18 p. m.	6:35 p. m.	0.54	5:20 p. m.	5:43 p. m.	0.01	0.10	0.20	0.34	0.45	0.49	.....	.....	.....	.....	.....	.....	.....	.....	.....
Raleigh, N. C	21	7:18 p. m.	10:25 p. m.	2.72	7:18 p. m.	8:18 p. m.	0.00	0.33‡	0.67‡	1.00‡	1.33‡	1.67‡	2.00‡	2.20‡	2.30‡	2.40‡	2.45‡	2.50‡	.....	.....	.....
Richmond, Va	2	.....	.....	0.81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.45	.....	.....	.....
Rochester, N. Y	12	.....	.....	0.43	.....	.....	.....	.....	.....	0.39	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Roswell, N. Mex	23	7:20 a. m.	9:20 a. m.	0.59	7:34 a. m.	7:59 a. m.	0.03	0.16	0.32	0.38	0.46	0.51	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	23	11:00 a. m.	1:15 p. m.	0.62	12:12 p. m.	12:38 p. m.	0.09	0.08	0.19	0.33	0.39	0.45	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	25	2:00 a. m.	11:25 a. m.	2.17	2:49 a. m.	3:09 a. m.	0.12	0.08	0.20	0.35	0.47	0.53	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis, Mo	10	.....	.....	0.67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.41	.....	.....	.....
St. Paul, Minn	28	.....	.....	0.75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.41	.....	.....	.....
Salt Lake City, Utah	14	.....	.....	0.40	.....	.....	.....	.....	.....	0.38	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Antonio, Tex	3-4	10:55 p. m.	2:00 a. m.	1.29	11:43 p. m.	12:07 a. m.	0.02	0.40	0.73	0.95	1.04	1.13	.....	.....	.....	.....	.....	0.08	.....	.....	.....
San Diego, Cal	14	.....	.....	0.16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sandusky, Ohio	3	4:06 p. m.	5:38 p. m.	0.84	4:37 p. m.	4:54 p. m.	0.06	0.21	0.55	0.68	0.71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Francisco, Cal	†	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Savannah, Ga	5	3:00 p. m.	6:30 p. m.	0.87	3:24 p. m.	3:49 p. m.	0.01	0.24	0.50	0.61	0.66	0.72	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	25	7:25 p. m.	9:30 p. m.	0.99	7:27 p. m.	7:52 p. m.	0.01	0.14	0.29	0.51	0.63	0.75	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	28	3:40 p. m.	5:40 p. m.	1.67	4:01 p. m.	4:38 p. m.	0.05	0.15	0.22	0.43	0.71	1.01	1.23	1.56	.....	.....	.....	.....	.....	.....	.....
Scranton, Pa	2	5:50 p. m.	9:00 p. m.	0.87	5:52 p. m.	6:22 p. m.	0.01	0.30	0.37	0.42	0.47	0.52	0.62	.....	.....	.....	.....	.....	.....	.....	.....
Seattle, Wash	13	.....	.....	0.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.09	.....	.....	.....
Shreveport, La	23	4:45 a. m.	1:45 p. m.	8.00	7:11 a. m.	8:01 a. m.	0.86	0.12	0.30	0.42	0.72	0.97	1.31	1.62	1.95	2.22	2.49	.....	.....	.....	.....
					8:01 a. m.	8:51 a. m.	.....	2.81	2.99	3.08	3.15	3.25	3.35	3.50	3.75	3.92	4.12	.....	.....	.....	.....
					8:51 a. m.	9:41 a. m.	.....	4.30	4.52	4.68	5.00	5.31	5.48	5.85	5.67	5.90	6.06	.....	.....	.....	.....
					9:41 a. m.	10:11 a. m.	.....	6.20	6.28	6.32	6.36	6.43	6.49	.....	.....	.....	.....	.....	.....	.....	.....
Spokane, Wash	15	.....	.....	0.03	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Springfield, Ill	1	1:32 p. m.	3:27 p. m.	0.98	1:32 p. m.	1:47 p. m.	0.00	0.16	0.51	0.58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	1	5:56 p. m.	6:36 p. m.	0.81	5:58 p. m.	6:15 p. m.	0.01	0.24	0.62	0.76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Springfield, Mo	26	3:40 p. m.	7:06 p. m.	2.94	4:13 p. m.	5:13 p. m.	0.41	0.32	0.75	1.01	1.35	1.52	1.58	1.66	1.78	2.00	2.12	2.26	.....	.....	.....
Do	26-27	8:36 p. m.	D. N.	1.25	8:36 p. m.	9:06 p. m.	0.00	0.24	0.49	0.61	0.69	0.75	0.81	.....	.....	.....	.....	.....	.....	.....	.....
Syracuse, N. Y	29	11:15 a. m.	8:30 p. m.	1.77	6:42 p. m.	7:18 p. m.	0.42	0.10	0.21	0.36	0.48	0.65	0.83	1.02	1.05	.....	.....	.....	.....	.....	.....
Tampa, Fla	12	4:30 p. m.	9:10 p. m.	2.18	4:40 p. m.	5:32 p. m.	0.02	0.08	0.34	0.64	0.72	0.78	0.78	0.80	0.84	0.99	1.26	1.55	1.87	1.99	.....
Do	13	12:50 p. m.	4:10 p. m.	1.63	1:12 p. m.	1:35 p. m.	0.02	0.30	0.62	0.98	1.19	1.39	.....	.....	.....	.....	.....	.....	.....	.....	.....
Taylor, Tex	8-9	D. N.	D. N.	0.85	12:00 mid't	12:15 a. m.	0.25	0.19	0.47	0.58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Toledo, Ohio	3	.....	.....	0.33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.32	.....	.....	.....
Topeka, Kans	2	12:18 p. m.	7:48 p. m.	3.48	1:12 p. m.	3:11 p. m.	0.03	0.13	0.23	0.28	0.34	0.42	0.47	0.53	0.64	0.78	0.95	1.18	1.26	1.80	2.30
Valentine, Nebr	29	.....	.....	0.50	.....	.....	.....	.....	.....	0.40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Vicksburg, Miss	5	2:44 p. m.	6:27 p. m.	1.74	2:51 p. m.	4:11 p. m.	0.01	0.06	0.22	0.40	0.79	1.00	1.04	1.08	1.27	1.30	1.39	1.49	1.70	.....	.....
Washington, D. C	5-6	7:22 p. m.	1:35 a. m.	3.69	7:28 p. m.	8:38 p. m.	0.01	0.30	0.54	0.75	0.93	1.11	1.42	1.74	1.83	1.99	2.25	2.72	3.23	.....	.....
Do	12	4:23 p. m.	6:30 p. m.	0.79	5:02 p. m.	5:27 p. m.	0.01	0.15	0.45	0.55	0.62	0.68	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	14	8:27 p. m.	10.30 p. m.	1.14	8:29 p. m.	9:04 p. m.	T.	0.06	0.30	0.64	0.75	0.84	0.90	0.99	.....	.....	.....	.....	.....	.....	.....
Do	19	4:35 p. m.	6:10 p. m.	0.94	4:38 p. m.	5:08 p. m.	T.	0.20	0.45	0.62	0.69	0.77	0.84	.....	.....	.....	.....	.....	.....	.....	.....
Wichita, Kans	29	5:10 p. m.	7:20 p. m.	0.68	6:10 p. m.	6:45 p. m.	0.04	0.10	0.32	0.39	0.45	0.51	0.58	0.62	.....	.....	.....	.....	.....	.....	.....
Do	29-30	7:40 p. m.	8:03 a. m.	2.79	8:33 p. m.	9:03 p. m.	0.18	0.10	0.28	0.35	0.65	0.80	0.93	.....	.....	.....	.....	.....	.....	.....	.....
Williston, N. Dak	1	3:52 p. m.	5:28 p. m.	0.53	4:32 p. m.	4:47 p. m.	0.02	0.14	0.37	0.47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wilmington, N. C	6	5:40 a. m.	7:25 a. m.	0.83	6:34 a. m.	7:04 a. m.	0.08	0.07	0.28	0.45	0.51	0.58	0.70	.....	.....	.....	.....	.....	.....	.....	.....
Do	21-22	11:45 p. m.	2:50 a. m.	1.77	11:53 p. m.	12:43 a. m.	0.02	0.14	0.17	0.17	0.30	0.46	0.66	0.93	1.19	1.40	1.51	.....	.....	.....	.....
Do	29	8:38 a. m.	9:25 a. m.	0.85	8:44 a. m.	9:04 a. m.	0.01	0.20	0.45	0.70	0.80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wytheville, Va	11-12	7:45 p. m.	5.16 p. m.	3.01	5:28 a. m.	6:07 a. m.	0.45	0.10	0.14	0.16	0.18	0.23	0.35	0.55	0.61	.....	.....	.....	.....	.....	.....
Do	18	12:32 p. m.	1:15 p. m.	0.75	12:42 p. m.	1:07 p. m.	0.05	0.14	0.35	0.40	0.63	0.71	.....	.....	.....	.....	.....	.....	.....	.....	.....
Yankton, S. Dak	13	.....	.....	0.26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.23	.....	.....	.....
Havana, Cuba	10	5:00 p. m.	5:45 p. m.	1.19	5:02 p. m.	5:30 p. m.	0.01	0.22	0.43	0.70	0.96	1.11	1.17	.....	.....	.....	.....	.....	.....	.....	.....
San Juan, Porto Rico	2	9:03 a. m.	1:40 p. m.	1.32	10:01 a. m.	10:40 a. m.	0.23	0.08	0.12	0.15	0.30	0.62	0.85	0.92	1.01	.....	.....	.....	.....	.....	.....
Do	12	12:16 p. m.	7:55 p. m.	2.91	3:01 p. m.	3:45 p. m.	0.21	0.19	0.24	0.45	0.63	0.75	0.97	1.22	1.40	1.76	.....	.....	.....	.....	.....
					4:40 p. m.	5:25 p. m.	2.02	0.06	0.31	0.40	0.54	0.63	0.67	0.70	0.79	0.85	.....	.....	.....	.....	.....

* Self-register not working † No precipitation during the month. ‡ Record partly estimated.

TABLE V.—*Data furnished by the Canadian Meteorological Service, July, 1905.*

Stations.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Pressure, in inches. Sea level, reduced to mean of 24 hours.	Pressure, in inches. Departure from normal.	Temperature. Mean.	Temperature. Departure from normal.	Temperature. Mean maximum.	Temperature. Mean minimum.	Precipitation. Total.	Precipitation. Departure from normal.	Precipitation. Total snowfall.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F	29.76	29.89	—.08	57.8	— 1.5	67.0	48.6	3.85	—0.04	
Sydney, C. B. I	29.91	29.95	+.02	64.4	+ 2.1	76.4	52.5	2.53	—1.12	
Halifax, N. S	29.86	29.96	.00	66.6	+ 3.2	77.7	55.4	1.92	—2.13	
Grand Manan, N. B	29.87	29.92	—.01	62.1	+ 0.5	70.4	53.8	2.31	—0.69	
Yarmouth, N. S	29.81	29.98	+.03	61.1	+ 1.6	68.7	53.4	2.56	—1.06	
Charlottetown, P. E. I	29.88	29.92	+.02	66.9	+ 2.8	75.2	58.6	2.67	—0.82	
Chatham, N. B	29.85	29.87	—.01	68.9	+ 3.9	81.3	56.5	3.38	—0.81	
Father Point, Que	29.84	29.86	+.01	59.8	+ 2.2	68.7	50.8	1.77	—1.27	
Quebec, Que	29.59	29.90	—.01	68.7	+ 3.2	78.4	59.0	2.59	—1.67	
Montreal, Que	29.70	29.90	—.03	69.9	+ 1.4	77.7	62.1	4.01	—0.28	
Rockliffe, Ont	29.30	29.83	—.11	67.4	+ 1.8	78.3	56.5	3.64	+0.52	
Ottawa, Ont	29.57	29.89	—.05	70.0	+ 0.5	78.6	61.4	4.10	+0.63	
Kingston, Ont	29.62	29.92	—.05	67.9	— 0.3	74.1	61.8	4.55	+1.66	
Toronto, Ont	29.56	29.92	—.05	69.7	+ 1.7	78.8	60.6	4.72	+1.80	
White River, Ont	28.59	29.88	—.06	60.4	+ 0.9	74.0	46.8	4.11	+1.31	
Port Stanley, Ont	29.31	29.94	—.04	68.8	+ 1.0	78.1	59.5	1.92	—1.12	
Saugeen, Ont	29.24	29.94	—.03	66.7	+ 2.0	74.5	58.9	2.65	+0.67	

Stations.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Pressure, in inches. Sea level, reduced to mean of 24 hours.	Pressure, in inches. Departure from normal.	Temperature. Mean.	Temperature. Departure from normal.	Temperature. Mean maximum.	Temperature. Mean minimum.	Precipitation. Total.	Precipitation. Departure from normal.	Precipitation. Total snowfall.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
Parry Sound, Ont	29.19	29.92	—.04	70.0	+ 4.0	78.7	61.3	3.61	+0.99	
Port Arthur, Ont	29.22	29.93	—.01	61.4	— 0.6	71.1	51.6	7.33	+3.85	
Winnipeg, Man	29.12	29.93	.00	65.3	— 0.7	76.6	54.0	4.35	+1.27	
Minnedosa, Man	28.19	29.97	+.04	63.2	+ 1.0	75.7	50.7	1.77	—0.83	
Qu'Appelle, Assin	27.75	29.97	+.05	62.6	— 0.9	73.7	51.4	2.93	+0.45	
Medicine Hat, Assin	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Swift Current, Assin	27.45	29.98	+.07	64.2	— 2.3	75.7	52.8	3.98	+1.54	
Calgary, Alberta	26.49	29.97	+.07	61.2	+ 0.6	75.2	47.1	0.91	—1.77	
Banff, Alberta	25.47	29.99	+.09	58.4	+ 1.8	72.9	43.8	1.43	—1.81	
Edmonton, Alberta	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Prince Albert, Sask	28.37	29.90	—.01	63.4	+ 1.5	76.3	50.6	0.95	—1.10	
Battleford, Sask	28.27	29.99	+.09	63.9	— 0.8	77.1	50.7	2.35	+0.01	
Kamloops, B. C	28.71	29.90	—.04	72.4	+ 3.9	85.7	59.1	0.62	—0.99	
Victoria, B. C	29.94	30.03	—.02	61.2	+ 1.2	69.0	53.4	0.10	—0.30	
Barkerville, B. C	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Hamilton, Bermuda	30.01	30.17	+.03	79.2	+ 0.8	84.7	73.7	5.32	+0.88	

TABLE VI.—*Heights of rivers referred to zeros of gages, July, 1905.*

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Milk River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Havre, Mont.	237	9	5.1	29	2.7	25	3.4	2.4
Musselshell River.								
Musselshell, Mont.	87	9	4.8	2	0.0	26–28	0.6	4.8
Yellowstone River.								
Billings, Mont.	330	8	6.1	2	2.5	31	4.0	3.6
Glendive, Mont.	78	17	8.8	1, 4	4.8	24, 25	6.5	4.0
Cheyenne River.								
Rousseau, S. Dak	7	9	12.0	4	1.0	23	3.7	11.0
James River.								
Lamoure, N. Dak	330	14	0.2	7, 8, 17–19	— 0.2	31	0.1	0.4
Huron, S. Dak.	139	9	5.5	1	0.3	23, 28–30	1.6	5.2
Big Blue River.								
Beatrice, Nebr.	92	14	6.0	3	2.1	24	3.0	3.9
Blue Rapids, Kans.	47	14	12.4	4	5.7	18, 19	7.7	6.7
Republican River.								
Clay Center, Kans.	42	18	22.0	7	8.5	21	12.2	13.5
Solomon River.								
Beloit, Kans	75	16	26.5	3	2.2	26, 27	7.9	24.3
Smoky Hill River.								
Lindsborg, Kans	109	20	24.0	2	3.1	30	7.5	20.9
Abilene, Kans.	45	22	21.2	8	4.0	24, 25	9.9	17.2
Kansas River.								
Manhattan, Kans.	116	18	15.1	9	5.2	26	8.8	9.9
Topeka, Kans.	87	21	17.6	10	8.4	22	11.7	9.2
Osage River.								
Bagnell, Mo	70	28	24.6	31	2.3	2, 22	7.5	22.3
Gasconade River.								
Arlington, Mo.	98	16	20.0	23	0.2	3, 4	3.9	19.8
Missouri River.								
Townsend, Mont.	2,504	11	5.4	1	3.1	26–30	3.7	2.3
Fort Benton, Mont.	2,285	12	3.2	1, 2	0.8	24, 27–31	1.6	2.4
Wolf Point, Mont.	1,952	17	2.6	7	— 0.7	31	1.4	3.3
Bismarck, N. Dak.	1,309	14	7.8	4, 5	3.6	31	5.7	4.2
Pierre, S. Dak.	1,114	14	.....	.....	.....	.....	.....	.....
Sioux City, Iowa	784	19	18.0	6	9.3	31	11.3	8.7
Blair, Nebr.	705	15	16.9	8	9.2	29	11.1	7.7
Omaha, Nebr	669	10	15.5	9	8.1	28, 29	10.5	7.4
Plattsmouth, Nebr.	641	17	11.6	9	5.2	27	7.6	6.4
St. Joseph, Mo	481	10	12.5	11	5.6	28	8.2	6.9
Kansas City, Mo.	388	21	23.0	12	13.1	29	17.3	9.9
Glasgow, Mo.	231	18	17.4	11, 13	10.4	31	14.1	7.0
Boonville, Mo.	199	20	19.9	13	11.2	31	15.2	8.7
Hermann, Mo.	103	24	19.6	14	12.3	28	15.6	7.3
Minnesota River.								
Mankato, Minn.	127	18	12.5	9	5.4	31	8.6	7.1
St. Croix River.								
Stillwater, Minn.	23	11	14.2	11	8.7	31	11.9	5.5
Chippewa River.								
Chippewa Falls, Wis.	75	16	8.7	8	1.5	31	3.7	7.2
Red Cedar River.								
Cedar Rapids, Iowa	77	14	5.4	8	3.6	31	4.4	1.8
Iowa River.								
Iowa City, Iowa.	57	.....	3.5	1	0.5	31	1.9	3.0
Des Moines River.								
Des Moines, Iowa.	205	19	7.0	14	4.1	31	5.2	2.9
Illinois River.								
La Salle, Ill	197	18	14.2	1	11.7	26–28	12.7	2.5
Peoria, Ill.	135	14	11.7	1	8.5	29–31	10.0	3.2
Beardstown, Ill.	70	12	11.5	3	8.5	31	10.0	3.0
Red Bank Creek.								
Brookville, Pa.	42	8	1.1	14	0.4	19–30	0.5	0.7
Clarion River.								
Clarion, Pa. (1)	32	10	5.7	5	0.8	29	2.3	4.9
Conemaugh River.								
Johnstown, Pa.	64	7	3.9	20, 30	2.0	19	2.7	1.9
Allegheny River.								
Warren, Pa.	177	14	5.8	7	0.7	28	1.9	5.1
Franklin, Pa	114	15	8.7	30	1.0	28	2.8	7.7
Parker, Pa.	73	20	8.7	30	1.1	28, 29	3.0	7.6
Freeport, Pa.	29	20	12.8	31	2.5	29	5.4	10.3
Springdale, Pa.	17	27	15.7	31	7.1	28	9.4	8.6
Cheat River.								
Rowlesburg, W. Va.	36	14	4.0	24	2.2	19	2.9	1.8
Youghiogheny River.								
Confluence, Pa.	59	10	3.0	8	0.6	19	1.5	2.4
West Newton, Pa.	15	23	3.7	9	0.9	29	2.1	2.8
Monongahela River.								
Weston, W. Va.	161	18	0.8	15	— 0.5	1	0.2	1.3
Fairmont, W. Va.	119	25	18.0	20	14.3	19	15.1	3.7
Greensboro, Pa.	81	18	10.6	20	7.4	19	8.4	3.2
Lock No. 4, Pa.	40	28	10.4	21	6.5	19	7.7	3.9
Beaver River.								
Ellwood Junction, Pa.	10	14	2.8	15	1.2	29	1.9	1.6
Muskingum River.								
Zanesville, Ohio	70	25	10.0	5, 6	8.0	28–31	8.7	2.0
Beverly, Ohio.	20	25	6.9	6	4.3	30	5.4	2.6
Little Kanawha River.								
Glenville, W. Va	77	20	3.0	23	0.6	2	1.4	2.4
Creston, W. Va.	38	20	6.0	25	3.0	19	4.3	3.0
New River.								
Radford, Va	155	14	19.0	13	0.4	1–3	2.1	18.6
Hinton, W. Va.	95	14	9.5	14	1.5	2	3.4	8.0
Great Kanawha River.								
Charleston, W. Va.	58	30	20.2	14	4.7	29	7.6	15.5
Scioto River.								
Columbus, Ohio.	110	17	3.0	8	1.8	26, 28–31	2.3	1.2
Licking River.								
Falmouth, Ky.	30	25	8.0	24	2.0	31	3.8	6.0
Miami River.								
Dayton, Ohio.	77	18	1.7	3, 4	0.7	30, 31	1.0	1.0
Kentucky River.								
Jackson, Ky.	287	24	9.7	23	4.5	4–7, 11, 12	5.7	5.2
Beattyville, Ky	254	30	5.6	23	0.7	20	1.5	4.9
High Bridge, Ky.	117	17	12.8	25	9.3	21	10.5	3.5

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Kentucky River.—Cont'd.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Frankfort, Ky.	65	31	8.8	25	6.0	21	7.0	2.8
Wabash River.								
Mount Carmel, Ill	75	15	7.2	14	3.4	8–11	4.8	3.8
Cumberland River.								
Burnside, Ky.	518	50	5.6	10	0.8	21	3.1	4.8
Celina, Tenn.	383	45	7.6	7	2.6	22	5.2	5.0
Carthage, Tenn.	308	40	8.8	2	2.6	23	4.9	6.2
Nashville, Tenn.	193	40	15.0	3	8.5	24, 25	10.6	6.5
Clarksville, Tenn.	126	42	18.2	4	5.5	26	10.7	12.7
Powell River.								
Tazewell, Tenn.	44	20	1.9	13	0.6	1, 2	1.1	1.3
Clinch River.								
Speers Ferry, Va.	156	20	2.1	23	— 0.5	5, 6, 18	0.2	2.6
Clinton, Tenn	52	25	7.5	25	3.8	20	4.8	3.7
South Fork Holston River.								
Bluff City, Tenn.	35	15	6.2	13	0.6	2–4	1.7	5.6
Holston River.								
Rotherwood, Tenn.	142	14	5.0	13	0.6	1–5, 11	1.5	4.4
Rogersville, Tenn.	103	14	6.3	13	1.7	2–6	2.7	4.6
French Broad River.								
Asheville, N. C.	144	6	6.0	13	0.2	31	1.6	5.8
Leadvale, Tenn.	70	15	9.6	13	0.0	1	1.5	9.6
Dandridge, Tenn.	46	15	11.2	13	1.2	2	2.7	10.0
Little Tennessee River.								
McGhee, Tenn.	17	20	8.7	13	3.1	31	4.0	5.6
Hiwassee River.								
Charleston, Tenn	18	22	7.7	13	0.7	29	2.4	7.0
Tennessee River.								
Knoxville, Tenn.	635	29	12.0	13	1.8	2, 5, 6	3.7	10.2
Loudon, Tenn.	590	25	9.3	14	2.0	10	3.4	7.3
Kingston, Tenn.	556	25	8.9	14	2.4	6, 7	3.6	6.5
Chattanooga, Tenn.	452	33	12.7	15	3.8	30, 31	5.8	8.9
Bridgeport, Ala.	402	24	9.0	15	2.3	31	4.1	6.7
Guntersville, Ala.	349	31	13.5	16	4.5	31	7.4	9.0
Florence, Ala.	255	16	8.2	17	2.5	31	4.5	5.7
Riverton, Ala.	225	26	12.3	3	5.0	31	7.5	7.3
Johnsonville, Tenn.	95	21	11.7	4	4.2	30, 31	7.1	7.5
Ohio River.								
Pittsburg, Pa.	966	22	9.9	31	2.9	19	5.6	7.0
Davis Island Dam, Pa.	960	25	11.0	31	3.9	29	6.1	7.1
Beaver Dam, Pa	925	27	13.8	31	4.8	29	7.9	9.0
Wheeling, W. Va.	875	36	10.6	31	3.1	30	7.2	7.5
Parkersburg, W. Va.	785	36	9.6	10	5.6	31	8.0	4.0
Point Pleasant, W. Va.	703	39	16.4	15	4.1	30	8.8	12.3
Huntington, W. Va.	660	50	20.0	15	7.3	31	13.0	12.7
Catlettsburg, Ky.	651	50	19.4	15	5.9	31	12.4	13.5
Portsmouth, Ohio	612	50	19.7	16	7.9	31	13.5	11.8
Maysville, Ky.	559	50	18.7	16	9.1	31	13.5	9.6
Cincinnati, Ohio.	499	50	21.0	1	12.8	31	15.8	8.2
Madison, Ind	413	46	18.8	1	11.0	31	13.7	7.8
Louisville, Ky.	367	28	8.3	1	5.4	31	6.4	2.9
Evansville, Ind.	184	35	19.0	1	10.4	10	13.3	8.6
Mount Vernon, Ind.	148	35	17.8	1	10.1	11	12.8	7.7
Paducah, Ky.	47	40	19.9	4	12.0	31	16.1	7.9
Cairo, Ill.	1	45	31.5	4–6	23.9	31	28.9	7.6
St. Francis River.								
Marked Tree, Ark.	104	17	9.5	1	6.7	15–18	7.9	2.8
Neosho River.								
Neosho Rapids, Kans.	326	22	20.2	5	0.4	25, 26	3.6	19.8
Iola, Kans.	262	10	7.0	7	0.3	24–26	1.9	6.7
Oswego, Kans.	184	20	12.7	2	0.5	25, 26	4.6	12.2
Fort Gibson, Ind. T.	3	22	18.0	31	12.0	1, 21	14.5	6.0
Canadian River.								
Calvin, Ind. T.	99	10	4.2	29	2.4	1	3.2	1.8
Black River.								
Blackrock, Ark.	67	12	12.8	12	4.0	1	9.8	8.8
White River.								
Calicorock, Ark	272	15	24.3	29	1.3	1, 2	7.3	23.0
Batesville, Ark.	217	18	24.4	30	3.5	2	9.1	20.9
Newport, Ark.	185	26	23.9	31	4.0	3	12.3	19.9
Clarendon, Ark.	75	30	23.3	24, 25	16.6	7	20.5	6.7
Arkansas River.								
Pueblo, Colo.	1,334	10	.....	.....	.....	.....	.....	.....
Wichita, Kans.	832	10	5.3	4	1.3	27–29	2.4	4.0
Tulsa, Ind. T.	551	16	6.7	8	3.2	25	4.3	3.5
Webbers Falls, Ind. T.	465	23	12.0	5, 6	6.2	1, 19	8.2	5.8
Fort Smith, Ark.	408	22	13.4	10	6.5	1	10.1	6.9
Dardanelle, Ark.	256	21	14.9	11	5.4	3	9.6	9.5
Little Rock, Ark.	176	23	16.1	12	6.6	5	10.7	9.5
Yazoo River.								
Greenwood, Miss.	175	38	15.8	6	2.9	29	9.1	12.9
Yazoo City, Miss.	80	25	12.7	11	5.0	31	9.5	7.7
Little River.								
Whitecliffs, Ark.	33	20	24.6	25	8.0	5	18.1	16.6
Ouachita River.								
Camden, Ark. (3)	304	39	40.7	2	28.4	10, 11	33.1	12.3
Monroe, La	122	40	39.8	17	35.3	5, 6	37.9	4.5
Red River.								
Arthur City, Tex.	688	27	19.5	9	8.0	3	12.2	11.5
Fulton, Ark.	515	28	27.3	12	16.4	20	22.7	10.9
Springbank, Ark.	441	29	30.3	15, 16	26.9	6	29.0	3.4
Shreveport, La.	327	29	22.7	18, 19, 24	20.1	8	21.7	2.6
Alexandria, La.	118	33	32.1	30, 31	27.1	3	30.5	5.0
Mississippi River.								
St. Cloud, Minn.	2,034	4	7.2	8, 9	2.0	31	4.6	5.2
St. Paul, Minn.	1,954	14	14.8	11	8.2	31	12.0	6.6
Red Wing, Minn.	1,914	14	10.9	12, 13	6.3	31	8.9	4.6
Reeds Landing, Minn	1,884	12	9.6	12	5.6	31	7.9	4.0
La Crosse, Wis.	1,819	12	10.8	14–16	7.7	31	9.5	3.1
Prairie du Chien, Wis.	1,759	18	12.3	18, 19	9.1	31	11.1	3.2
Dubuque, Iowa.	1,699	18	13.6	1	10.2	31	12.0	3.4
Clinton, Iowa.	1,629	16	13.1	1	10.0	31	11.3	3.1
Leclaire, Iowa.	1,609	10	8.6	1–3	6.7	31	7.5	1.9
Davenport, Iowa.	1,593	15	11.8	2, 3	8.9	31	10.1	2.9

TABLE VI.—*Heights of rivers referred to zeros of gages.*—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River—Cont'd.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Muscatine, Iowa	1,562	16	13.0	1–3	10.4	31	11.5	2.6
Galland, Iowa	1,472	8	7.0	1,3	5.3	19, 20, 31	5.9	1.7
Keokuk, Iowa	1,463	15	13.2	3	9.1	31	10.7	4.1
Warsaw, Ill	1,458	18	16.3	3	12.4	30, 31	13.7	3.9
Hannibal, Mo	1,402	13	14.7	4	10.6	31	12.2	4.1
Grafton, Ill	1,306	23	17.3	7	12.4	31	15.2	4.9
St. Louis, Mo	1,264	30	25.8	15	17.6	29, 30	22.0	8.2
Chester, Ill	1,189	30	22.8	16	15.6	30	19.6	7.2
New Madrid, Mo	1,003	34	25.6	6	19.8	31	23.6	5.8
Luxora, Ark	905	33	19.3	7, 8	14.4	31	17.5	4.9
Memphis, Tenn	843	33	23.3	8, 9	17.8	31	21.3	5.5
Helena, Ark	767	42	31.5	10	25.6	31	29.3	5.9
Arkansas City, Ark	635	42	35.8	13–15	30.5	1	33.9	5.3
Greenville, Miss	595	42	29.8	14, 15	24.8	1	28.0	5.0
Vicksburg, Miss	474	45	33.3	15–17	27.2	1	31.4	6.1
Natchez, Miss	373	46	35.2	18, 19	30.3	1	33.6	4.9
Baton Rouge, La	240	35	26.8	18	24.1	2	25.7	2.7
Donaldsonville, La	188	28	20.9	18, 19	18.6	2	20.0	2.3
New Orleans, La	108	16	13.5	19	12.1	3, 4	13.0	1.4
Atchafalaya River.								
Simmesport, La	127	33	32.7	18–20	29.9	3, 4	31.6	2.8
Melville, La	103	31	32.0	18–21	30.4	3, 4	31.4	1.6
Morgan City, La	19	8	5.2	10	3.0	21	4.1	2.2
Grand River.								
Grand Rapids (2)	38	11	3.6	14	1.7	27, 28	2.4	1.9
Connecticut River.								
Hartford, Conn	50	13	6.1	6, 7	1.2	28	10.0	4.9
Mohawk River.								
Tribeshill, N. Y	42	12	4.2	4	0.1	1, 2	0.9	4.1
Schenectady, N. Y.	19	15	5.0	3	1.0	18, 19, 23–25, 30, 31	1.6	4.0
Hudson River.								
Troy, N. Y	154	14	7.6	1	2.7	19, 27	3.9	4.9
Albany, N. Y. (1)	147	12	7.1	4	1.4	26	3.9	5.7
Pompton River.								
Pompton Plains, N. J	6	8	3.8	1	3.2	29–31	3.5	0.6
Lehigh River.								
Mauchchunk, Pa	45	15	4.3	12, 13	4.0	1–4, 28, 29	4.2	0.3
Schuylkill River.								
Reading, Pa	66	12	0.9	6	0.1	1, 2, 23, 24 26–28	0.3	0.8
Delaware River.								
Hancock (E. Branch), N. Y.	269	12	3.9	3	2.8	{1, 19, 24, 28, 29}	3.0	1.1
Hancock (W. Branch), N. Y.	269	10	4.4	3	2.9	29, 30	3.2	1.5
Port Jervis, N. Y	204	14	1.4	4	−0.3	21, 26	0.1	1.7
Phillipsburg, N. J	142	26	1.7	5	0.3	22	0.7	1.4
Trenton, N. J	92	18	1.5	6	0.5	29, 30	0.8	1.0
North Branch Susquehanna.								
Binghamton, N. Y	183	16	3.4	3	2.1	{19, 23, 24, 29}	2.4	1.3
Towanda, Pa	139	16	5.2	3	1.3	23, 30	1.8	3.9
Wilkesbarre, Pa	60	17	8.0	4	3.4	24, 25	4.4	4.6
West Branch Susquehanna.								
Williamsport, Pa	39	20	6.5	9	1.3	28, 29	2.5	5.2
Juniata River.								
Huntingdon, Pa	90	24	4.3	14	3.2	28, 29	3.5	1.1
Susquehanna River.								
Harrisburg, Pa	69	17	3.2	11	1.6	23, 25, 27	2.3	1.6
Shenandoah River.								
Riverton, Va	58	22	0.6	1–31	0.6	1–31	0.6	0.0
Potomac River.								
Cumberland, Md	290	8	6.2	7, 8	2.6	21	3.3	3.6
Harpers Ferry, W. Va	172	18	5.9	15	1.4	22	3.0	4.5
James River.								
Buchanan, Va	305	12	14.3	13	2.8	1–5	4.5	11.5
Lynchburg, Va	260	18	12.2	13	1.0	1, 2, 31	2.8	11.2
Columbia, Va	167	18	21.3	14	3.5	4	7.8	17.8
Richmond, Va	111	12	9.9	15	0.0	2	1.8	9.9
Dan River.								
Danville, Va	55	8	2.4	7	−0.1	1	0.8	2.5
Roanoke River.								
Clarksville, Va	196	12	7.3	15	−0.4	1–3	2.1	7.7
Weldon, N. C	129	30	30.5	15	8.7	3	14.7	21.8
Tar River.								
Tarboro, N. C	46	25	11.1	26	2.6	5	5.9	8.5
Greenville, N. C	21	22	10.8	27, 29	4.2	6	7.3	6.6
Haw River.								
Moncure, N. C	171	25	22.0	14	0.9	1	4.3	21.1
Cape Fear River.								
Fayetteville, N. C	112	38	35.2	15	2.7	4	11.2	32.5
Waccamaw River.								
Conway, S. C	40	7	5.2	28, 29	2.0	1–5	3.8	3.2
Pedee River.								
Cheraw, S. C	149	27	26.3	15	1.4	4	6.5	24.9
Smiths Mills, S. C	51	16	13.3	24	1.6	6, 7	7.8	11.7
Lynch Creek.								
Effingham, S. C	35	12	8.6	22, 23	3.3	7	5.5	5.3
Black River.								
Kingstree, S. C. (1)	45	12	3.7	20	0.9	8	2.0	2.8
Catawba River.								
Mount Holly, N. C	28	15	11.0	14	1.8	{1, 3, 4, 27, 28}	3.0	9.2
Wateree River.								
Camden, S. C	37	24	29.8	16	3.7	3	10.8	26.1
Broad River.								
Blairs, S. C	36	14	9.3	14	0.6	26	2.9	8.7
Saluda River.								
Chappels, S. C	56	14	14.1	15	1.9	1	6.7	12.2

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Congaree River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Columbia, S. C	52	15	9.6	14	0.7	1	2.9	8.9
Santee River.								
St. Stephens, S. C	50	12	9.4	25	0.2	4	6.7	9.2
Edisto River.								
Edisto, S. C	75	6	1.7	6	0.0	11–15, 24–30	0.8	1.7
Broad River.								
Carlton, Ga	30	11	8.2	6	1.7	28–31	2.9	6.5
Savannah River.								
Calhoun Falls, S. C	347	15	13.0	2	2.1	29	4.6	10.9
Augusta, Ga	268	32	23.0	3	6.0	1	11.0	17.0
Oconee River.								
Milledgeville, Ga	147	25	8.9	9	1.2	30	3.1	7.7
Dublin, Ga	79	30	5.5	10	−0.5	26	1.4	6.0
Ocmulgee River.								
Macon, Ga	203	18	8.2	14	0.9	25	3.5	7.3
Abbeville, Ga	96	11	6.2	7, 18	1.1	26–28	3.7	5.1
Flint River.								
Woodbury, Ga	227	10	2.6	2, 3	−0.1	24	6.7	2.7
Montezuma, Ga	152	20	7.5	4, 5	1.8	31	3.4	5.7
Albany, Ga	90	20	4.4	5, 6	0.5	28	1.8	3.9
Bainbridge, Ga	29	22	6.1	6, 7	3.3	25, 26	4.3	2.8
Chattahoochee River.								
Oakdale, Ga	305	18	14.0	12	2.5	28	5.1	11.5
West Point, Ga	239	20	8.7	13	1.4	29	3.9	7.3
Eufaula, Ala	90	40	9.5	14	2.0	1, 26, 27	4.2	7.5
Alaga, Ala	30	25	12.7	15	2.9	25	5.6	9.8
Coosa River.								
Rome, Ga	271	30	8.0	13	0.8	29	2.7	7.2
Gadsden, Ala	144	22	8.5	14	0.6	29, 30	2.7	7.9
Lock No. 4, Ala	116	17	7.0	14	0.9	30	2.8	6.1
Wetumpka, Ala	6	45	10.7	15	2.8	29	5.7	7.9
Tallapoosa River.								
Milstead, Ala	38	35	3.5	14	1.2	23	1.9	2.3
Alabama River.								
Montgomery, Ala	265	35	7.0	16	1.1	29	3.2	5.9
Selma, Ala	212	35	8.6	16	1.6	23–31	4.1	7.0
Black Warrior River.								
Tuscaloosa, Ala	90	43	15.3	1	5.1	23	8.1	10.2
Tombigbee River.								
Columbus, Miss	303	33	4.5	1	−0.4	21–24, 26	1.3	4.9
Vienna, Ala	233	42	6.8	6	1.0	24, 25	2.9	5.8
Demopolis, Ala	155	35	11.4	3	−0.8	25	5.1	12.2
Leaf River.								
Hattiesburg, Miss	60	20	6.6	12	3.0	23, 24, 30, 31	3.9	3.6
Chickasawhay River.								
Enterprise, Miss	144	18	5.8	1	1.2	28	2.3	4.6
Shubuta, Miss	106	25	9.0	1	3.3	28–31	4.6	5.7
Pascagoula River.								
Merrill, Miss	78	20	6.4	14	2.2	31	4.0	4.2
Pearl River.								
Jackson, Miss	242	20	5.1	1	1.7	25, 28	2.8	3.4
Columbia, Miss	110	14	10.2	12	5.0	30, 31	6.5	5.2
Sabine River.								
Logansport, La	315	25	30.3	27	19.0	1	25.5	11.3
Neches River.								
Rockland, Tex	105	20	20.5	12	5.7	31	12.7	14.8
Beaumont, Tex	18	10	3.9	1, 2, 21–24	1.8	11	3.1	2.1
Trinity River.								
Dallas, Tex	320	25	33.8	12	5.4	3	18.7	28.4
Long Lake, Tex	211	35	39.9	24	29.3	1, 2	35.7	10.6
Riverside, Tex	112	40	38.0	1	21.3	22	25.8	16.7
Liberty, Tex	20	25	11.6	8, 9	3.4	10	7.3	8.2
Brazos River.								
Kopperl, Tex	345	21	12.4	27	4.2	3, 4	6.8	8.2
Waco, Tex	285	24	17.2	28	4.1	22	7.3	13.1
Valley Junction, Tex	215	40	20.8	29	4.0	24, 25, 27	7.8	16.8
Hempstead, Tex	140	40	35.4	1	5.6	28	14.0	29.8
Booth, Tex	61	39	33.3	1	5.2	27	13.9	28.1
Colorado River.								
Ballinger, Tex	489	21	14.0	28	1.7	2–4	3.3	12.3
Austin, Tex	214	18	5.8	31	1.4	29	2.6	4.4
Columbus, Tex	98	24	15.2	11	7.6	30, 31	9.9	7.6
Guadalupe River.								
Gonzales, Tex	112	22	8.8	10	0.8	28, 30	1.7	8.0
Victoria, Tex	35	16	15.1	12	2.2	31	4.6	12.9
Rio Grande River.								
San Marcial, N. Mex	1,233	11	8.1	1	5.9	31	6.7	2.2
El Paso, Tex	1,030	14	9.5	1	6.1	30, 31	7.2	3.4
Red River of the North.								
Moorhead, Minn	284	26	10.4	13	9.6	4	10.1	0.8
Kootenai River.								
Bonners Ferry, Idaho	123	24	15.0	6	8.9	31	12.1	6.1
Pend d' Oreille River.								
Newport, Wash	86	14	7.3	1	2.4	31	4.8	4.9
Snake River.								
Lewiston, Idaho	144	24	5.0	1	1.1	31	2.6	3.9
Riparia, Wash	67	30	6.0	1	1.4	26–31	3.0	4.6
Columbia River.								
Wenatchee, Wash	473	40	25.6	1	19.2	26, 27	22.0	6.4
Umatilla, Oreg	270	25	12.7	1	8.9	27–31	10.5	3.8
The Dalles, Oreg	166	40	19.8	1	12.6	29	15.5	7.2
Willamette River.								
Albany, Oreg	118	20	1.8	1	0.8	24–31	1.2	1.0
Salem, Oreg	84	20	1.0	1	0.3	24, 31	0.5	0.7
Portland, Oreg	12	15	10.6	1	6.2	25–28	8.0	4.4
Sacramento River.								
Red Bluff, Cal	201	23	1.5	1, 2	0.4	30, 31	0.9	1.1
Sacramento, Cal	64	25	11.3	1	8.2	28–31	6.3	3.1

(1) one day missing. (2) 22 days only. (3) 15 days only.

Honolulu, T. H., latitude, 21° 19′ north, longitude 157° 52′ west; barometer above sea, 38 feet; gravity correction, —.057 applied. July, 1905.

Day.	Pressure.*		Air temperature.				Moisture.				Wind.				Precipitation.		Clouds.					
							8 a. m.		8 p. m.		8 a. m.		8 p. m.				8 a. m.			8 p. m.		
	8 a. m.	8 p. m.	8 a. m.	8 p. m.	Maximum.	Minimum.	Wet.	Relative humidity.	Wet.	Relative humidity.	Direction.	Velocity.	Direction.	Velocity.	8 a. m.	8 p. m.	Amount.	Kind.	Direction.	Amount.	Kind.	Direction.
1	30.04	30.00	77.4	75.6	80	73	67.9	61	67.1	64	e.	6	ne.	3	T.	T.	6	Cu.	ne.	7	S.-cu.	ne.
2	30.04	30.01	75.4	74.5	80	71	68.2	69	67.0	68	se.	3	ne.	5	T.	T.	2 5	S.-cu. N.	se. se.	4	S.-cu.	e.
3	30.02	30.03	74.4	70.3	80	69	68.1	72	66.3	81	e.	8	ne.	14	0.12	0.03	6 2	S.-cu. N.	e. e.	8	N.	?
4	30.03	29.99	75.4	74.5	80	69	65.7	60	65.0	64	ne.	12	ne.	16	0.12	0.00	4	S.-cu.	e.	2	S.-cu.	e.
5	30.00	29.97	77.2	74.4	81	71	66.7	57	66.8	67	ne.	8	ne.	5	0.00	0.00	1 2	Ci.-s. Cu.	w. e.	6	S.-cu.	ne.
6	29.98	29.94	74.0	72.4	77	70	68.4	76	65.5	69	ne.	8	ne.	20	0.01	0.03	2 6	Cu. N.	e. e.	4 1	A.-s. Cu.	ne. e.
7	29.95	29.94	76.3	73.5	81	71	66.3	59	66.0	67	ne.	9	ne.	13	0.00	0.00	fi w.	S.-cu.	e.	few.	S.-cu.	e.
8	30.00	30.01	76.5	76.0	80	69	69.3	70	68.0	66	se.	4	e.	2	0.00	0.22	10	S.-cu.	se.	10	S.-cu.	s.
9	30.06	30.06	78.0	75.3	84	73	70.7	70	68.4	70	e.	6	ne.	3	0.00	0.00	9	S.-cu.	e.	1	Cu.	e.
10	30.08	30.03	78.3	75.2	82	72	67.4	57	68.5	71	ne.	11	e.	8	0.00	T.	2	Cu.	e.	1 1	Cu. N.	e. e.
11	30.02	29.98	78.0	76.2	82	73	69.6	65	69.0	69	e.	11	e.	4	T.	T.	5	Cu.	e.	4	Cu.	e.
12	29.97	29.94	77.7	75.7	82	73	69.4	66	68.2	68	ne.	14	e.	8	0.00	0.00	1	Cu.	e.	2	Cu.	ne.
13	29.96	29.88	77.1	74.5	80	73	67.5	61	71.0	84	ne.	15	ne.	11	0.00	0.05	2 1	Cu. S.-cu.	ne. 0	10	N.	e.
14	29.84	29.89	76.5	76.4	80	70	71.2	77	72.8	84	w.	6	s.	12	0.17	T.	7	S.-cu.	n.	9	S.-cu.	s.
15	30.02	30.03	79.4	75.2	84	72	72.8	73	71.2	82	e.	9	e.	11	0.04	T.	6 3	A.-cu. Cu.	s. s.	3 5	Cu. N.	e. e.
16	30.04	30.04	79.1	76.0	81	74	70.6	66	69.0	70	ne.	7	ne.	6	T.	T.	6 2	Ci.-s. S.-cu.	w. e.	3	S.-cu.	ne.
17	30.04	29.99	76.3	75.0	82	71	68.7	68	67.1	66	ne.	6	ne.	10	T.	0.09	3 1	Cu. S.-cu.	e. e.	6	S.-cu.	e.
18	30.01	30.00	76.5	74.2	81	72	68.5	66	68.0	73	ne.	8	ne.	15	0.00	T.	2	Cu.	e.	3	S.-cu.	e.
19	30.02	29.99	76.0	75.0	81	71	69.4	72	68.4	72	e.	8	e.	3	0.01	T.	1 8	Ci.-s. S.-cu.	0 e.	1	S.-cu.	e.
20	30.03	29.98	76.8	75.4	83	73	70.8	74	70.3	78	ne.	10	e.	8	0.00	T.	2 6	Cu. S.-cu.	e. e.	1 3	Ci.-s. S.-cu.	w. e.
21	29.97	29.95	78.3	76.9	83	73	69.9	66	71.4	77	ne.	18	ne.	13	0.00	0.00	1	Cu.	e.	1 7	Ci.-cu. S.-cu.	sw. e.
22	29.96	29.99	79.0	76.1	81	72	73.3	76	73.0	86	e.	2	nw.	2	0.02	T.	4 5	Ci.-cu. S.-cu.	sw. s.	8 2	A.-s. S.-cu.	w. e.
23	30.02	30.02	76.7	76.5	80	73	72.1	80	71.2	77	w.	4	n.	3	T.	0.05	8 1	Ci.-cu. Cu.	w. 0	5	S.-cu.	0
24	30.03	30.01	79.2	76.3	83	73	70.0	63	67.5	65	ne.	5	ne.	12	0.00	0.00	1	Cu.	e.	1 3	Cu. S.-cu.	e. e.
25	30.02	29.99	75.2	76.0	81	72	69.6	76	68.0	66	ne.	6	ne.	9	T.	T.	9	N.	ne.	8	S.-cu.	e.
26	30.02	29.95	75.3	75.3	80	69	65.8	60	67.3	66	ne.	11	ne.	5	0.04	0.01	4 2	Cu. S.-cu.	e. e.	3 5	Cu. N.	e. e.
27	29.95	29.95	76.5	76.0	82	71	68.7	67	69.5	72	ne.	7	e.	6	0.02	T.	1 1	Cu. S.-Cu.	ne. ne.	1	Cu.	e.
28	29.98	30.01	79.3	76.2	84	74	70.4	64	69.0	69	ne.	11	ne.	9	0.00	0.00	1	Cu.	e.	2	Cu.	e.
29	30.02	30.01	78.5	75.0	82	72	69.0	62	69.0	74	ne.	6	ne.	12	0.00	0.00	1	Cu.	ne.	1	Cu.	e.
30	30.02	30.01	78.5	77.4	84	71	71.8	72	70.0	69	ne.	2	ne.	7	0.01	0.00	3	Cu.	ne.	3	S.-cu.	e.
31	30.03	30.06	78.2	76.8	82	74	71.0	70	70.1	72	ne.	6	ne.	14	0.01	0.02	4	Cu.	e.	5	S.-cu.	e.
Mean	30.005	29.989	77.1	75.3	81.4	71.7	69.3	67.6	68.7	71.8	ne.	8.0	ne.	8.7	0.57	0.41	5.1	Cu.	e.	4.8	S.-cu.	e.

Observations are made at 8 a. m. and 8 p. m., local standard time, which is that of 157° 30′ west, and is 5h and 30m slower than 75th meridian time. *Pressure values are reduced to sea level and standard gravity.

RAINFALL IN JAMAICA.

Through the kindness of Mr. H. H. Cousins, chemist to the government of Jamaica and now in charge of the meteorological service of that island, we have received the following tables:

Comparative tables of rainfall.

[Based upon the average stations only.]

MARCH, 1905.

Divisions.	Relative area.	Number of stations.	Rainfall.	
			1905.	Average.
	Per cent.		*Inches.*	*Inches.*
Northeastern division	25	24	9.68	4.62
Northern division	22	38	6.96	2.73
West-central division	26	24	8.44	4.63
Southern division	27	36	4.83	2.64
Means	100		7.48	3.66

APRIL, 1905.

Northeastern division	25	24	3.31	5.68
Northern division	22	40	2.94	3.29
West-central division	26	25	9.67	7.48
Southern division	27	33	4.63	4.26
Means	100		5.14	5.18

MAY, 1905.

Northeastern division	25	26	12.86	11.03
Northern division	22	40	3.82	7.06
West-central division	26	22	9.41	12.03
Southern division	27	32	6.71	7.56
Means	100		5.70	9.42

JUNE, 1905.

Northeastern division	25	26	12.42	10.69
Northern division	22	47	7.21	5.38
West-central division	26	27	11.05	10.11
Southern division	27	33	9.72	6.58
Means	100		10.10	8.19

JULY, 1905.

Northeastern division	25	26	3.51	7.22
Northern division	22	50	1.19	3.11
West-central division	26	25	4.44	7.91
Southern division	27	33	1.77	4.09
Means	100		2.73	5.58

The rainfall for March was a little more than twice the average for the whole island. The greatest fall, 24.15 inches, occurred at Moore Town, in the northeastern division, while 0.93 inch fell at Bull Bay, in the southern division.

The rainfall for April was a little below the average for the whole island. The greatest fall, 23.56 inches, occurred at Shrewsbury in the southern division, while the least rain, 0.36 inch, was recorded at Worthy Park, in the central subdivision.

The rainfall for May was considerably below the average for the whole island. The greatest fall, 32.86 inches, was recorded at Ecclesdown in the northwestern division, while the least rain, 0.25 inch, occurred at Rose Hall, in the northern division.

The rainfall for June was much above the average for the whole island. The greatest fall occurred at Ecclesdown in the northeastern division, while the least, 1.77 inches, was recorded at Long Hill, in the southern division.

The rainfall for July was a little below half the average for the whole island. The greatest fall, 13.58 inches, occurred at Moore Town in the northeastern division, while no rain fell at Falmouth and other stations in the northern division, also at Ballast Ground and Pepper, in the southern division.

MEXICAN CLIMATOLOGICAL DATA.

By Señor MANUEL E. PASTRANA, Director of the Central Meteorologic-Magnetic Observatory.

July, 1905.

Stations.	Altitude.	Mean barometer.*	Temperature.			Relative humidity.	Precipitation.	Prevailing direction.	
			Max.	Min.	Mean.			Wind.	Cloud.
	Feet.	*Inches.*	° *F.*	° *F.*	° *F.*	%	*Ins.*		
Aguascalientes (Seminario.)	6,330	24.12	85.3	52.9	65.5	67	1.27	ne.	.....
C. Juarez	3,805	26.11	97.2	66.2	80.4	75	1.55	ne.	.....
Colima Seminario	1,663	28.48	95.0	66.0	78.6	77	4.46	sw.	.....
Chihuahua	4,684	25.27	98.6	54.1	76.6	44	3.71	se.	.....
Guadalajara (Seminario.)	5,186	25.09	84.2	58.1	68.4	72	6.80	ne, nw.	.....
Guanajuato	6,720	23.67	87.8	52.3	67.6	61	6.79	ne.	.....
Hugotitan Hda (Jalasco.)	5,228	24.91	86.4	48.2	67.3	86	6.98	se.	.....
Jalapa	4,681	25.55	77.0	56.7	65.8	86	7.80	n.	.....
Leon	5,906	24.30	87.4	54.9	67.6	69	7.83	s.	.....
Mexico (Obs. Cent.)	7,472	23.03	84.2	53.1	62.8	68	2.65	nw.	ne.
Morelia (Seminario)	6,401	23.91	78.8	52.7	64.0	73	6.07	.....	.....
Oaxaca	5,063	25.09	93.2	52.4	72.7	62	2.13	wnw.	.....
Panal	5,674	24.54	93.6	57.9	71.1	.....	6.44	e.	.....
Puebla (Col. d Est.)	7,118	23.34	94.5	48.6	62.2	73	4.76	ne.	.....
San Juan de Ulnor	39	29.90	88.7	70.0	81.1	83	11.24	e.	.....
San Luis Potosi	6,202	24.04	86.0	54.9	65.3	62	2.56	e.	.....
Valladolid (Yucatan)	82	29.98	96.4	69.4	80.8	80	6.83	se.	.....
Zacatecas	8,015	22.56	79.5	48.4	62.1	63	6.46	e.	.....

*The monthly barometric means are reduced to the international standard of gravity.

Chart I. Tracks of Centers of High Areas, July, 1905.

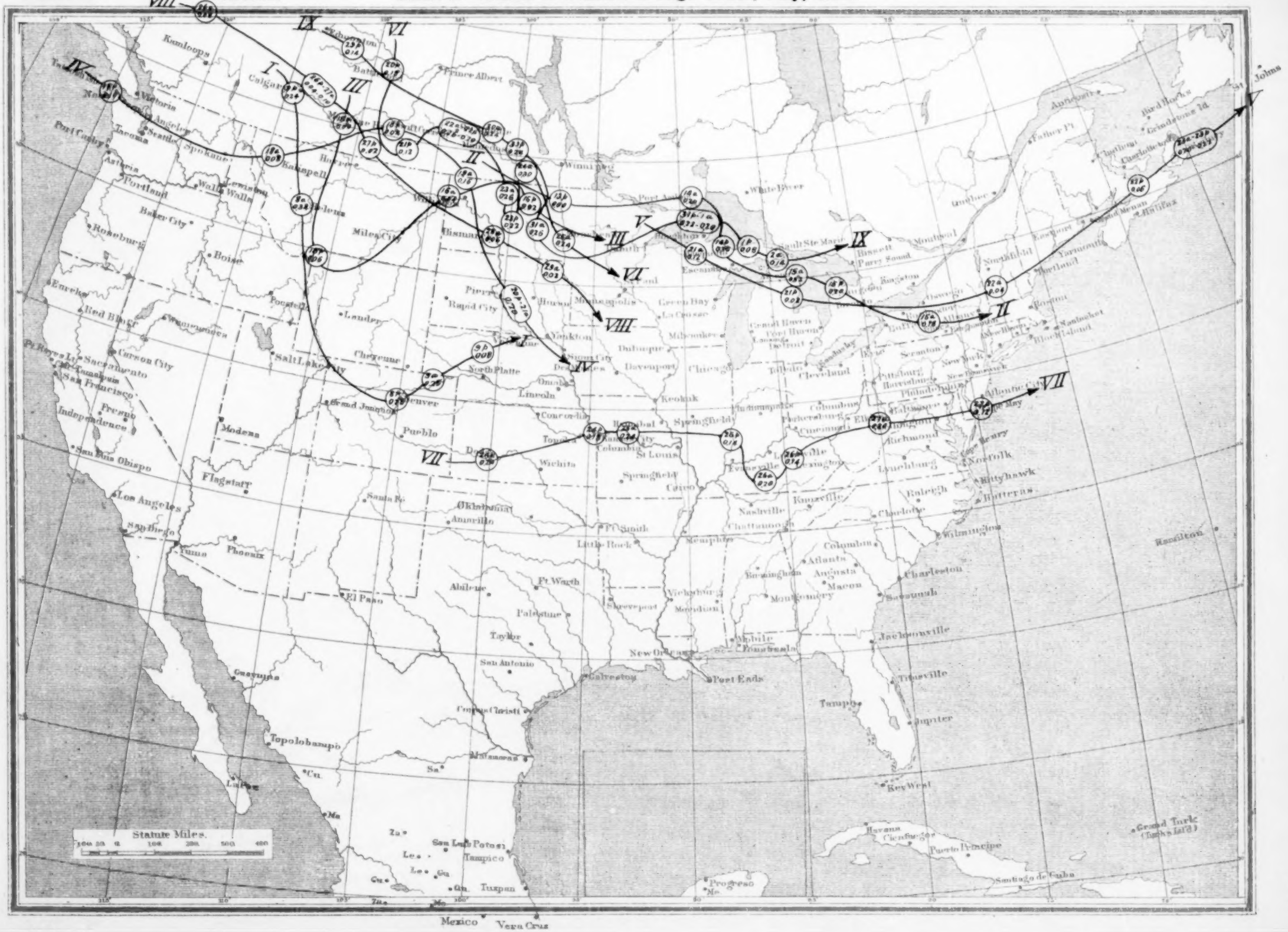
Barkerville
Kamloops
Prince Albert
Calgary
Victoria
Seattle
Spokane
Tacoma
Portland
Walla Walla
Lewiston
Baker City
Roseburg
Boise
Helena
Miles City
Bismarck
Pierre
Rapid City
Huron
Minneapolis
Green Bay
La Crosse
Milwaukee
Dubuque
Davenport
Chicago
Toledo
Cleveland
Pittsburg
Buffalo
Scranton
New York
Boston
Portland
Yarmouth
Halifax
Grand Manan
Father Pt
Quebec
White River
Winnipeg
Port Arthur
Sault Ste Marie
Escanaba
Parry Sound
Kingston
Oswego
Montreal
Green River
Laramie
Cheyenne
North Platte
Omaha
Lincoln
Concordia
Keokuk
Springfield
Columbia
St Louis
Cairo
Evansville
Louisville
Cincinnati
Columbus
Parkersburg
Richmond
Lynchburg
Norfolk
Kittyhawk
Hatteras
Raleigh
Charlotte
Nashville
Knoxville
Chattanooga
Memphis
Little Rock
Ft Smith
Wichita
Oklahoma
Amarillo
Santa Fe
Albuquerque
Ft Worth
Abilene
Palestine
Taylor
San Antonio
Galveston
Port Eads
New Orleans
Shreveport
Vicksburg
Meridian
Mobile
Pensacola
Montgomery
Atlanta
Augusta
Macon
Columbus
Birmingham
Charleston
Savannah
Jacksonville
Titusville
Tampa
Jupiter
Key West
Havana
Cienfuegos
Puerto Principe
Santiago de Cuba
Grand Turk (Turks Isld)
Progreso
Tampico
San Luis Potosi
Tuxpan
Mexico
Vera Cruz
Guaymas
Topolobampo
Mazatlan
Los Angeles
San Diego
Yuma
Phoenix
El Paso
Flagstaff
Modena
Independence
Fresno
San Luis Obispo
Carson City
Sacramento
San Francisco
Red Bluff
Eureka
Portland
Astoria
Port Crescent
Tacoma
Seattle
Spokane
Walla Walla
Lewiston
Kalispell
Havre
Bismarck
Miles City
Helena
Boise
Roseburg
Salt Lake City
Denver
Grand Junction
Pueblo
Trinidad
Albuquerque
Santa Fe
Amarillo
Oklahoma
Wichita
Ft Smith
Little Rock
Memphis
Nashville
Knoxville
Chattanooga
Columbia
Atlanta
Augusta

Chart II. Tracks of Centers of Low Areas, July, 1905.

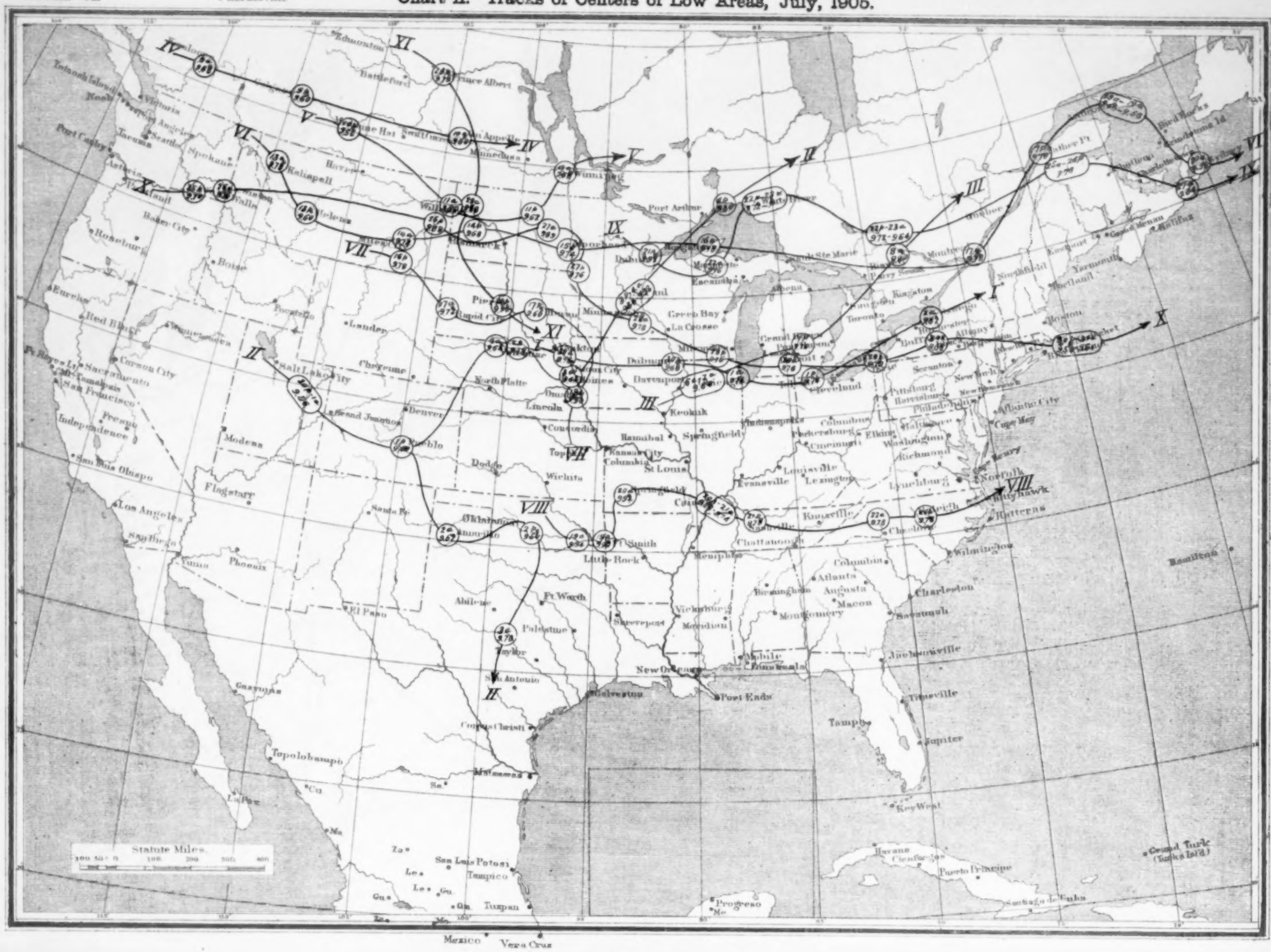

Chart III. Total Precipitation, July, 1905.

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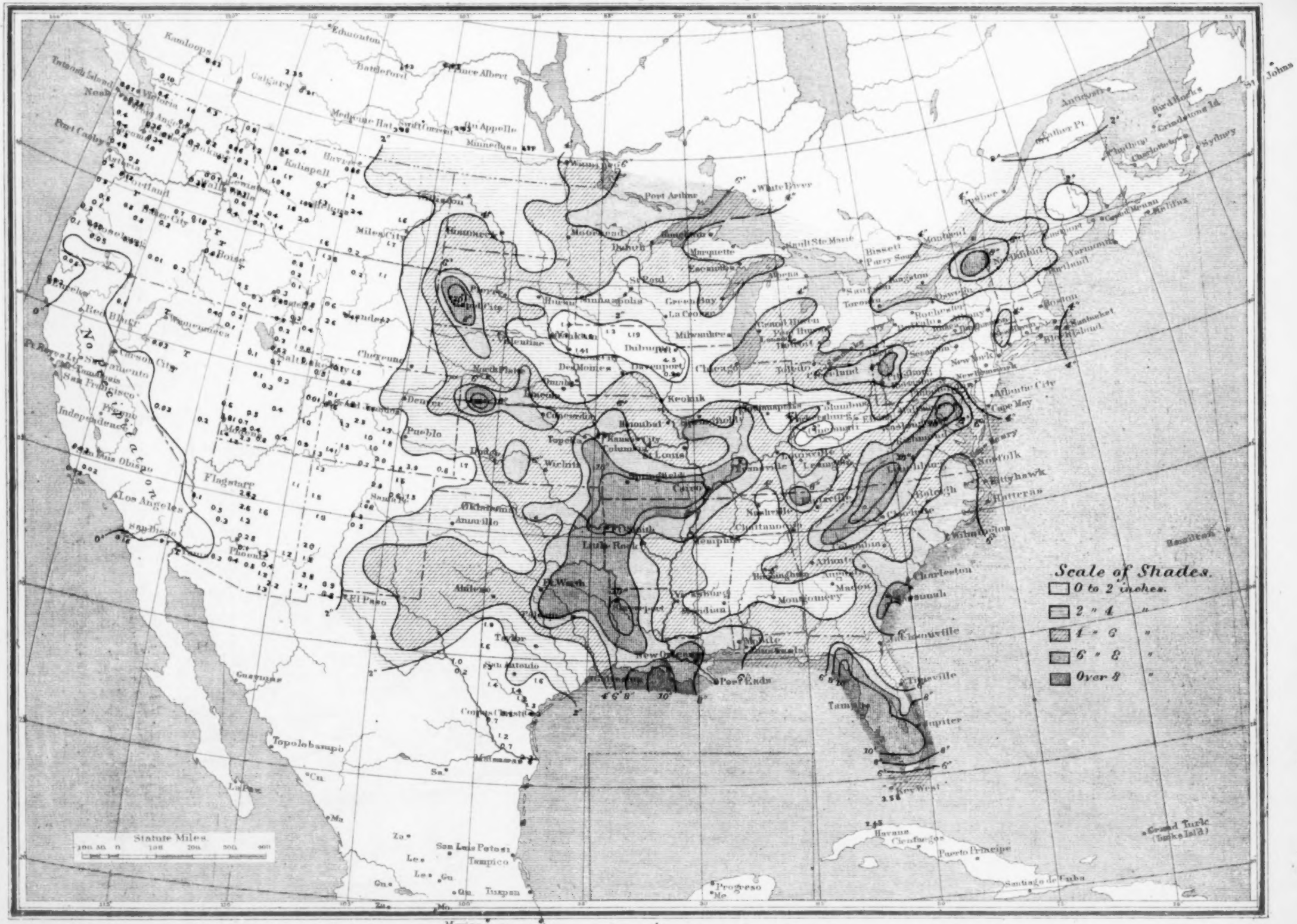


Chart IV. Percentage of Clear Sky, July, 1905.

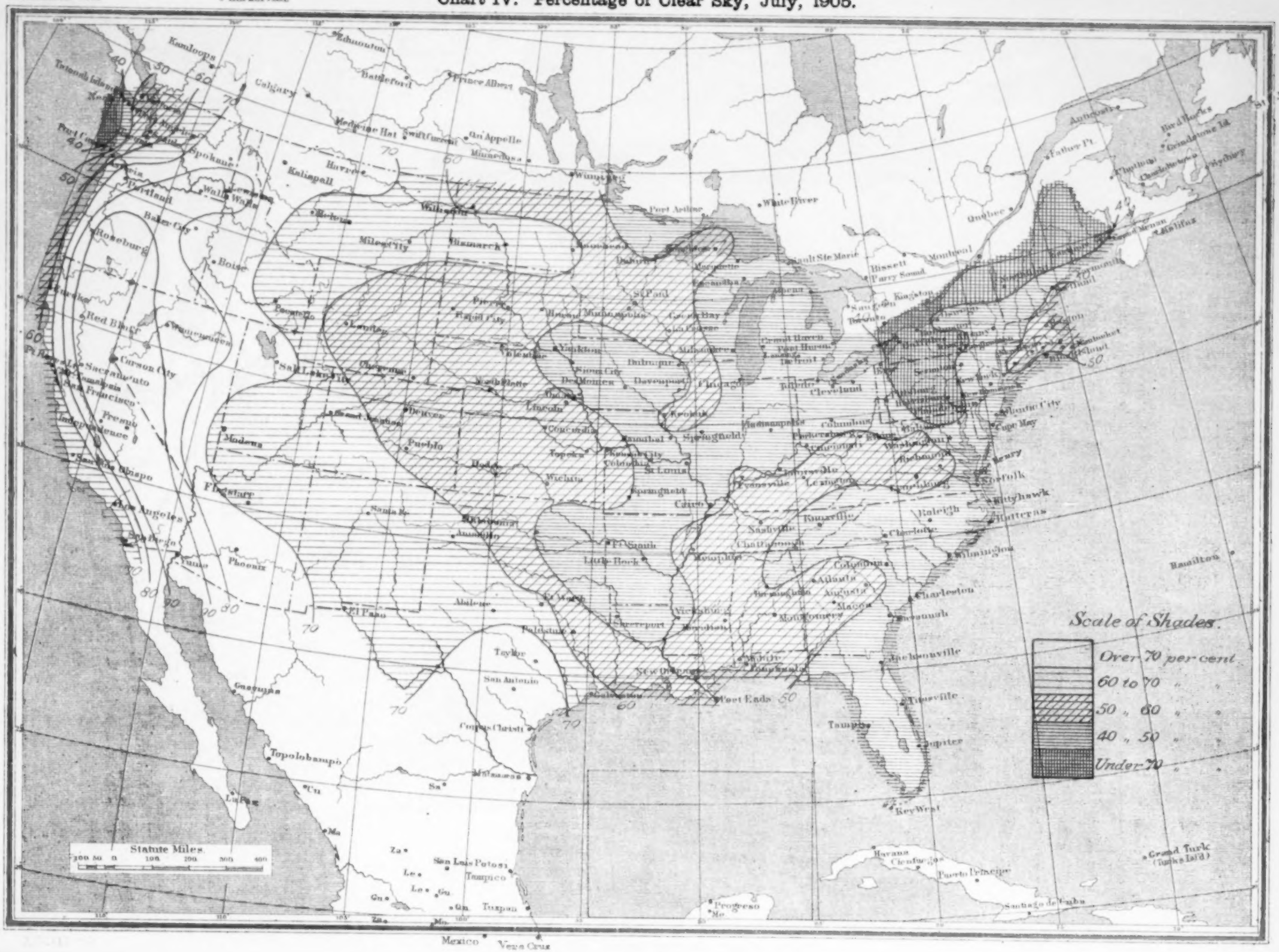
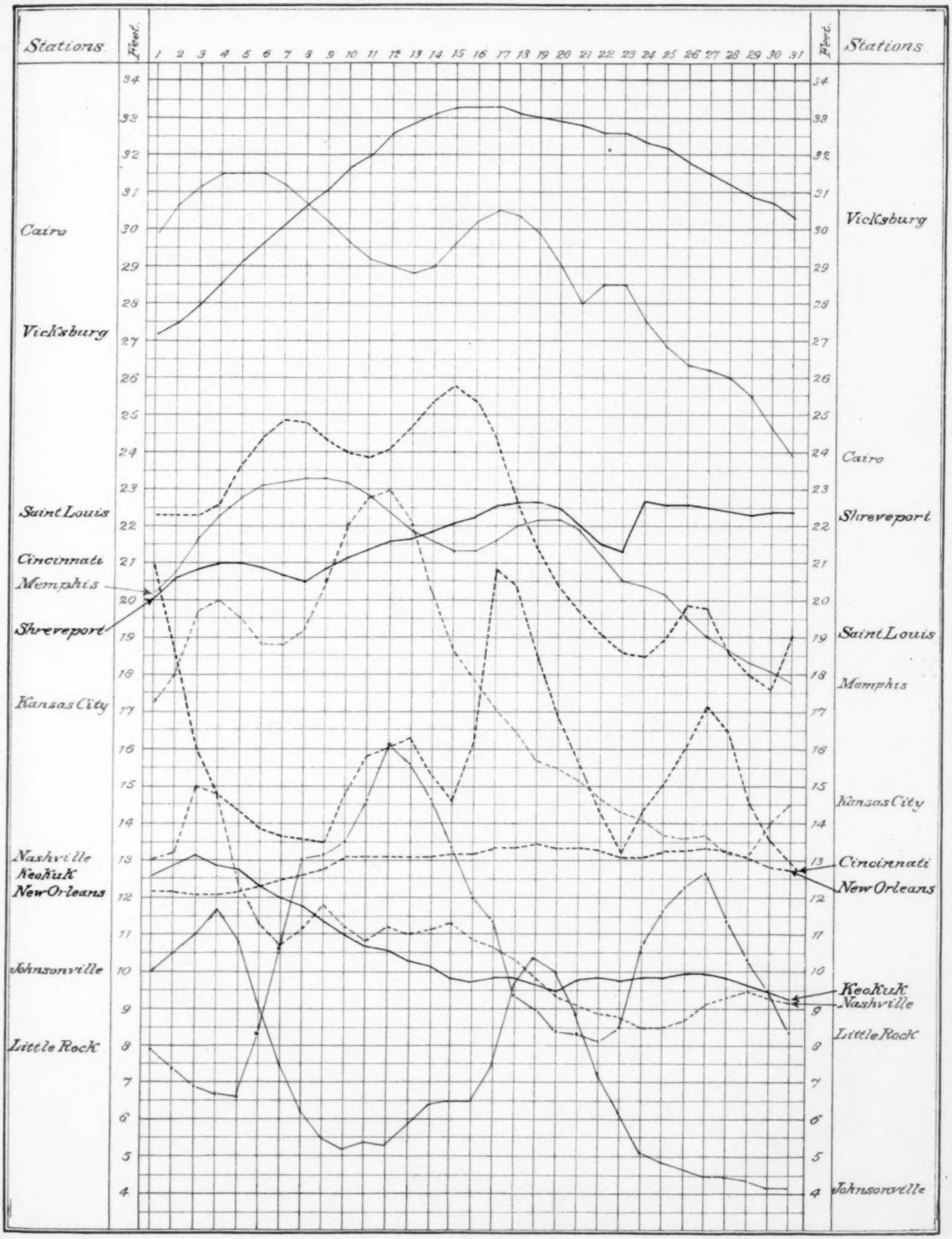


Chart V. Hydrographs for Seven Principal Rivers of the United States, July, 1905.


Stations
Feet.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4
Cairo
Vicksburg
Saint Louis
Cincinnati
Memphis
Shreveport
Kansas City
Nashville
Keokuk
New Orleans
Johnsonville
Little Rock

Barkerville

Chart VI. Isobars and Isotherms at 10,000 feet, July, 1905.

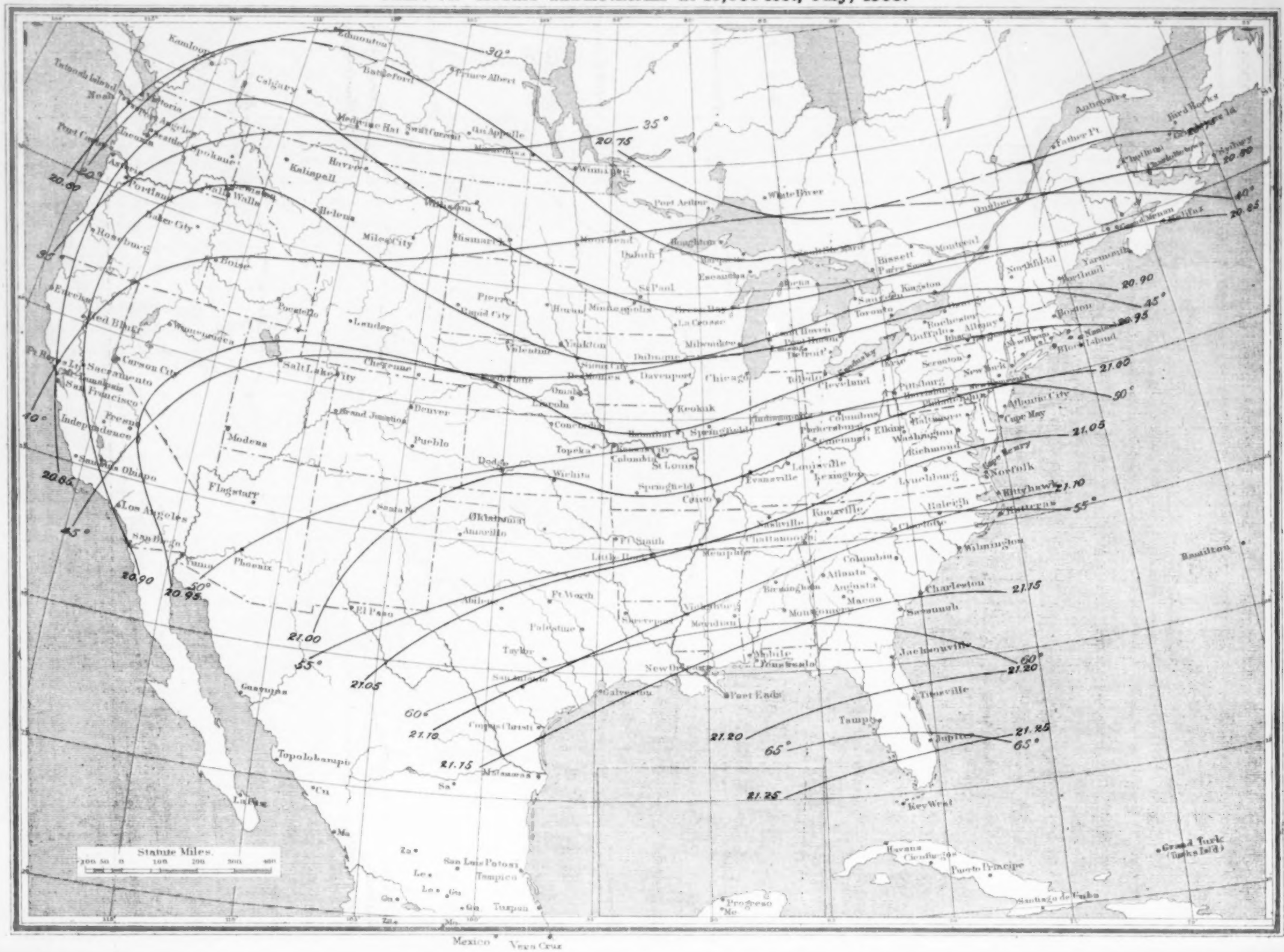


Chart VII. Isobars and Isotherms at 3500 feet, July, 1905.

Chart VII. Isobars and Isotherms at 3500 feet, July, 1905.

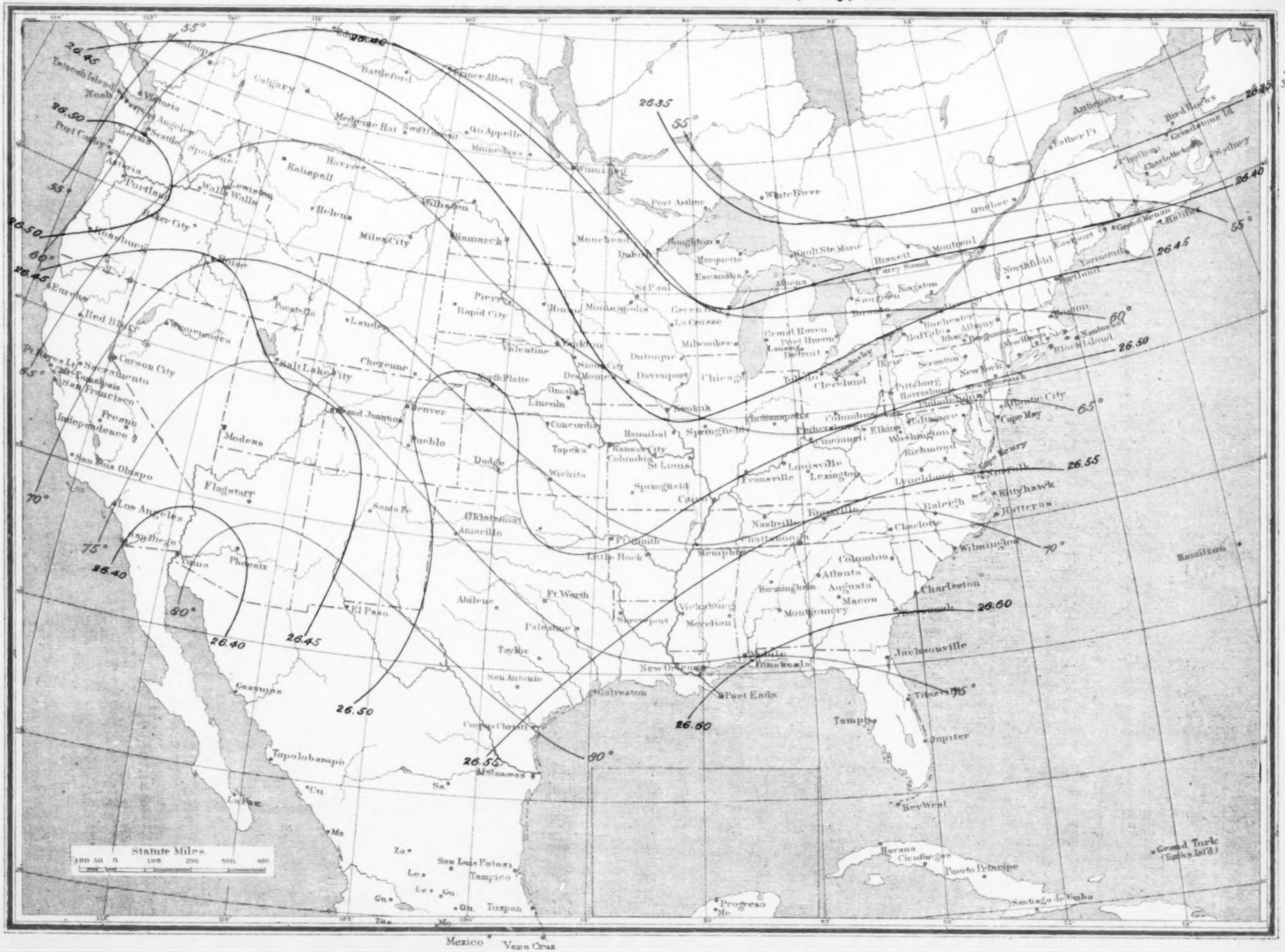


Chart VIII. Isobars and Isotherms at Sea Level; Resultant Surface Winds, July, 1905.

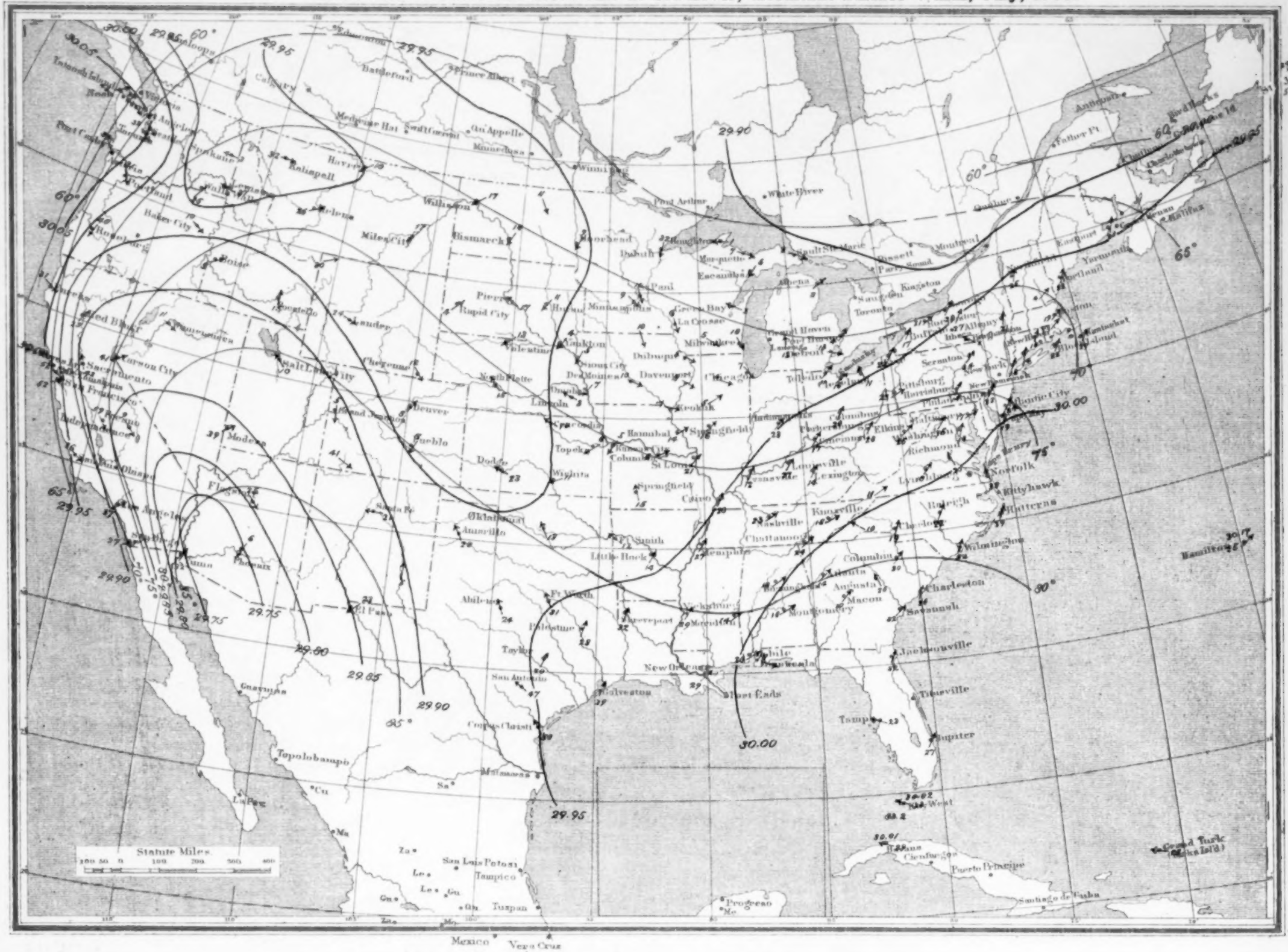


Chart IX. Sea-Level Isobars, Surface Temperatures, and Resultant Winds, July, 1905.

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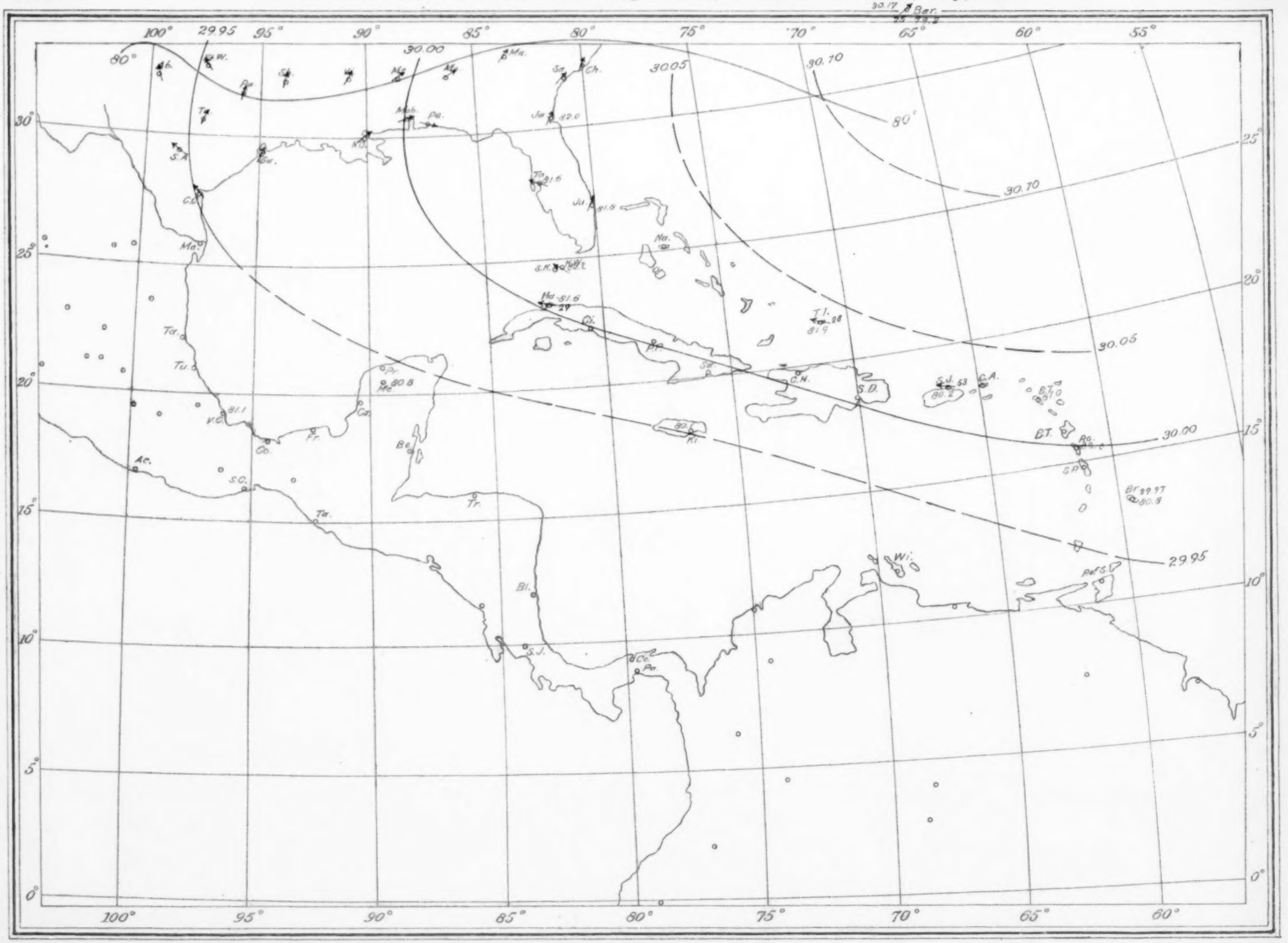
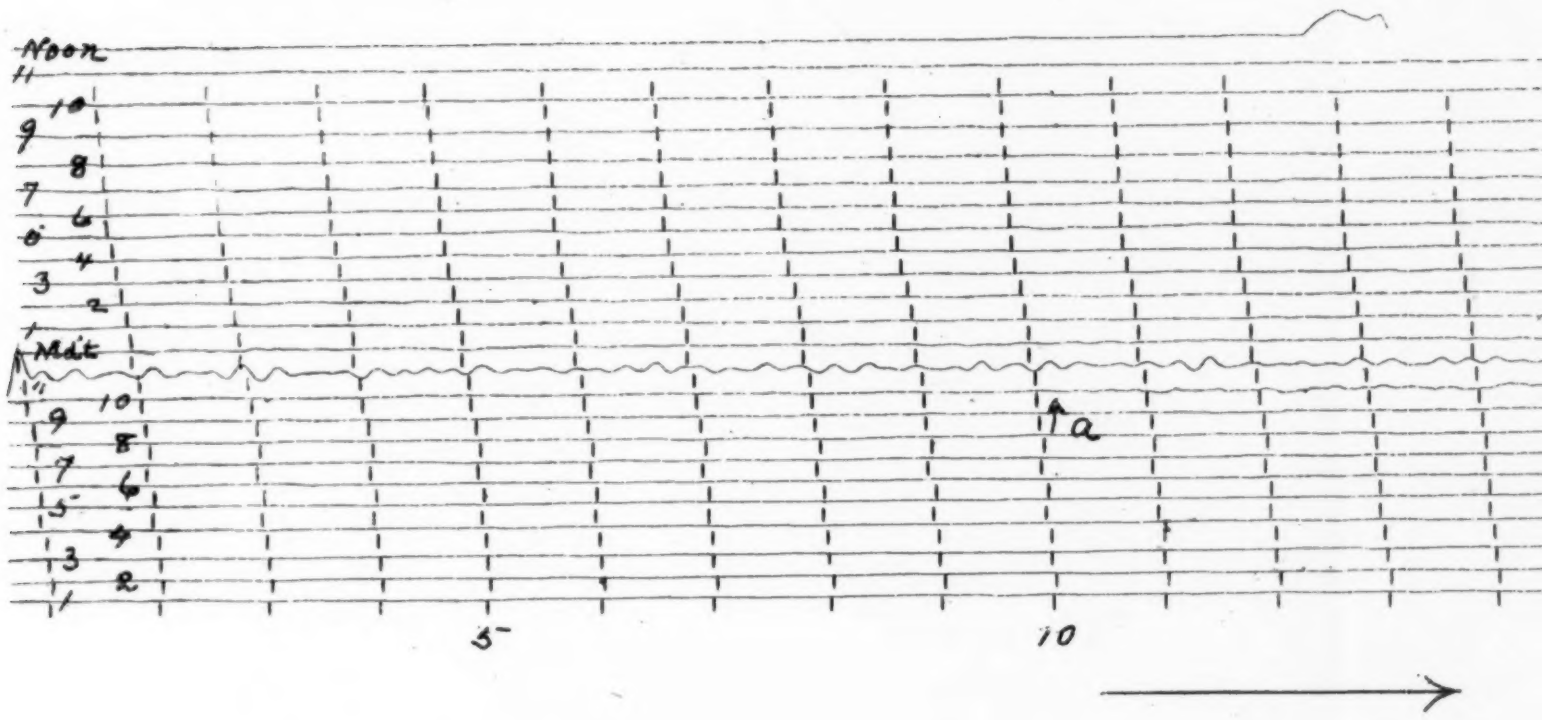
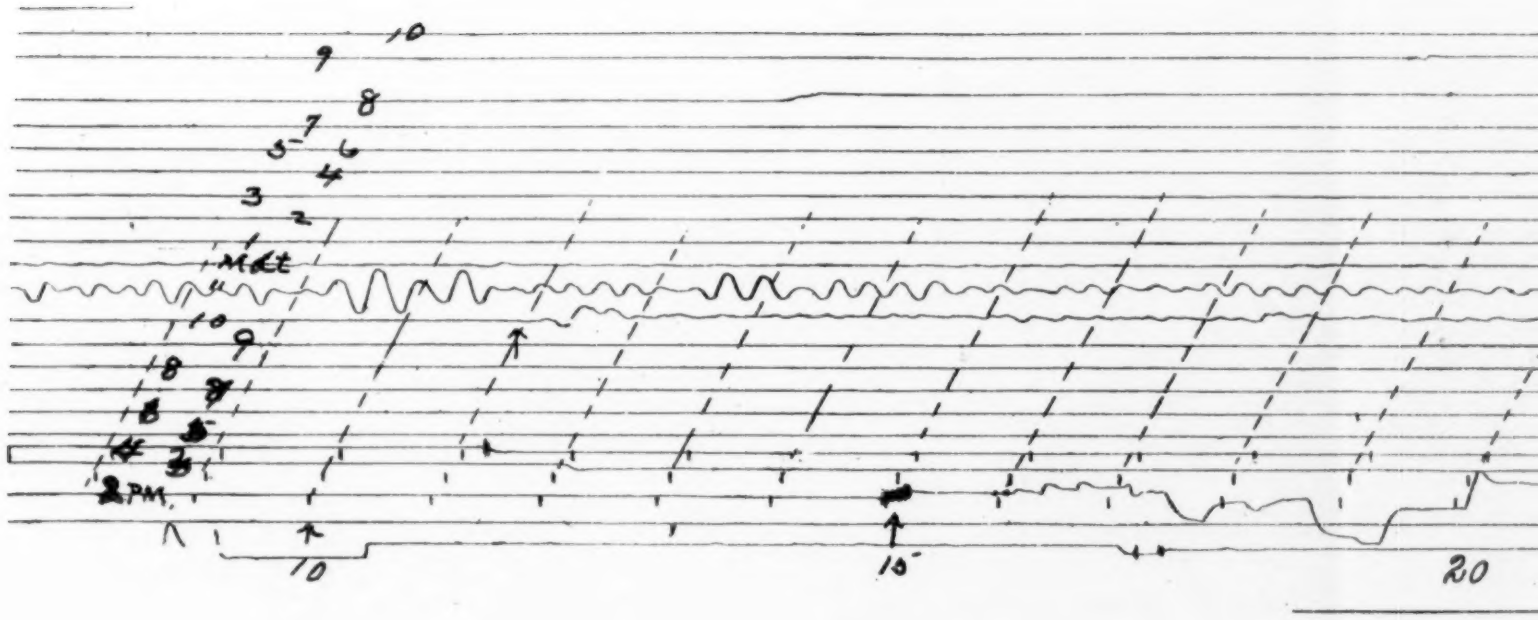
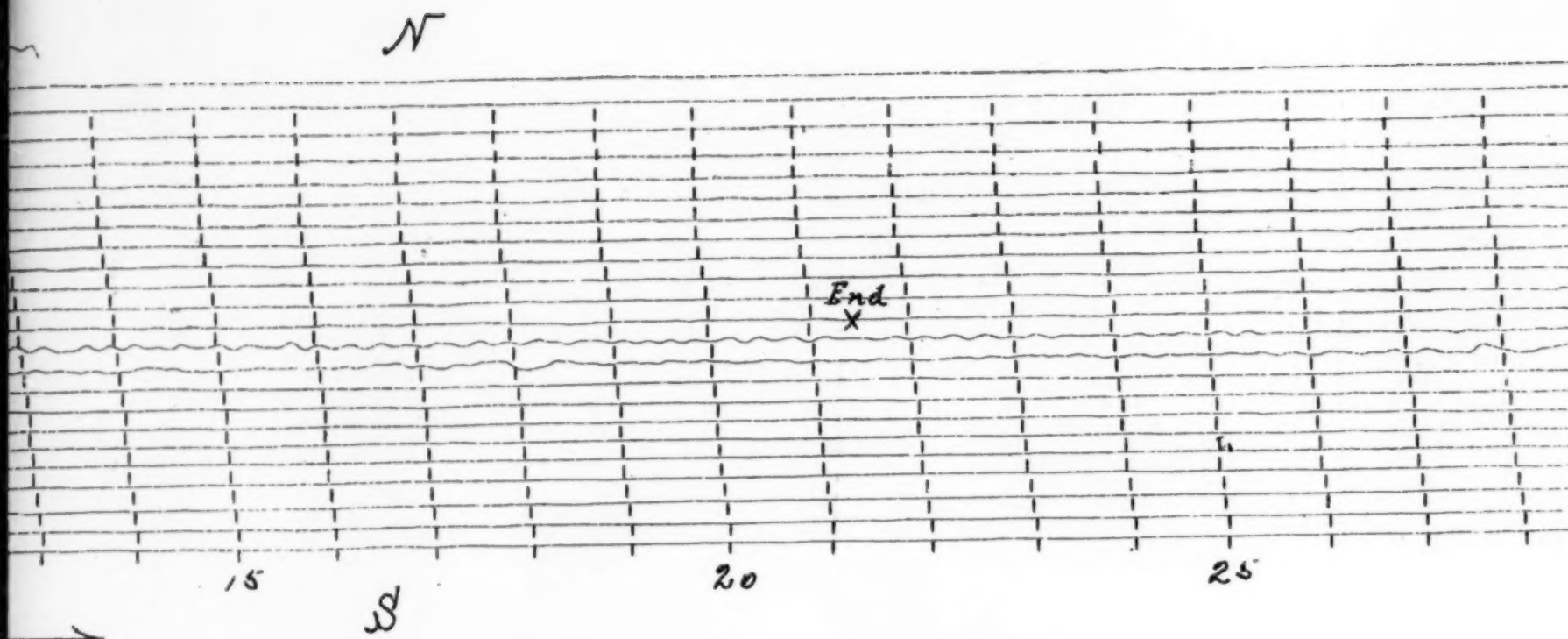
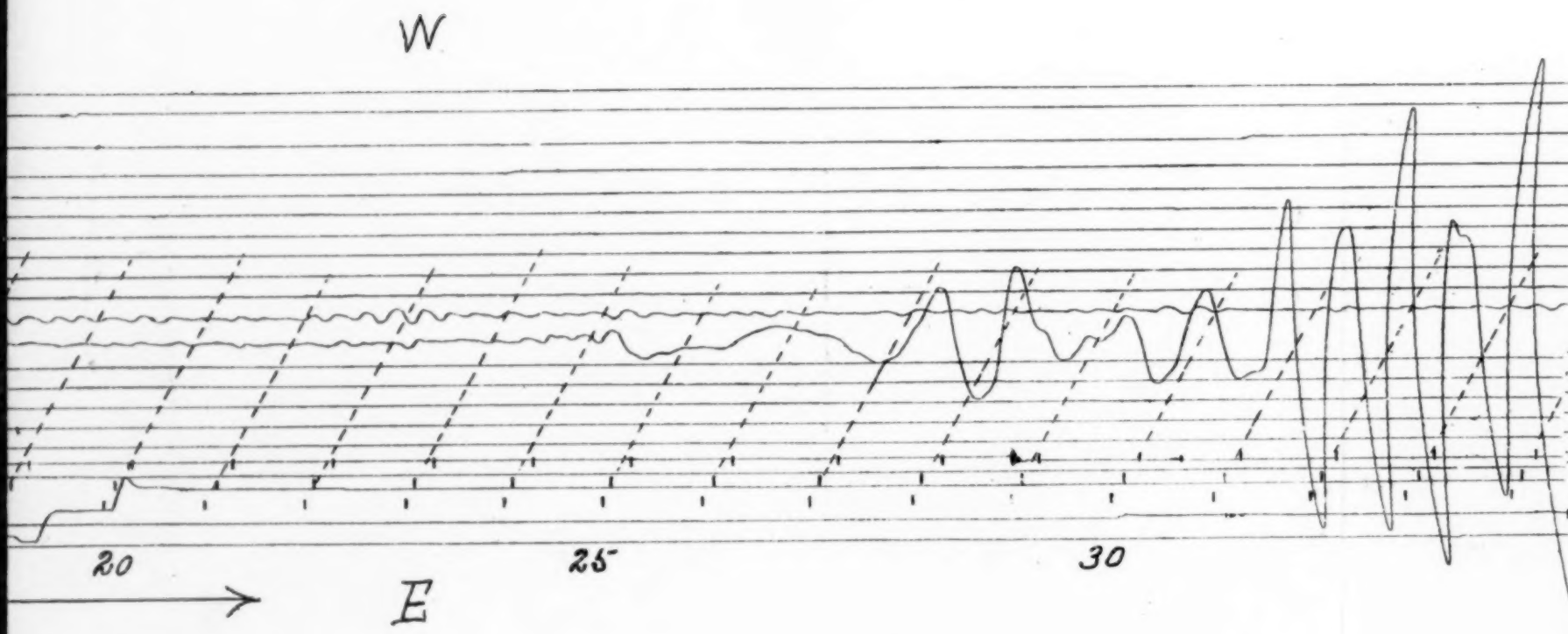


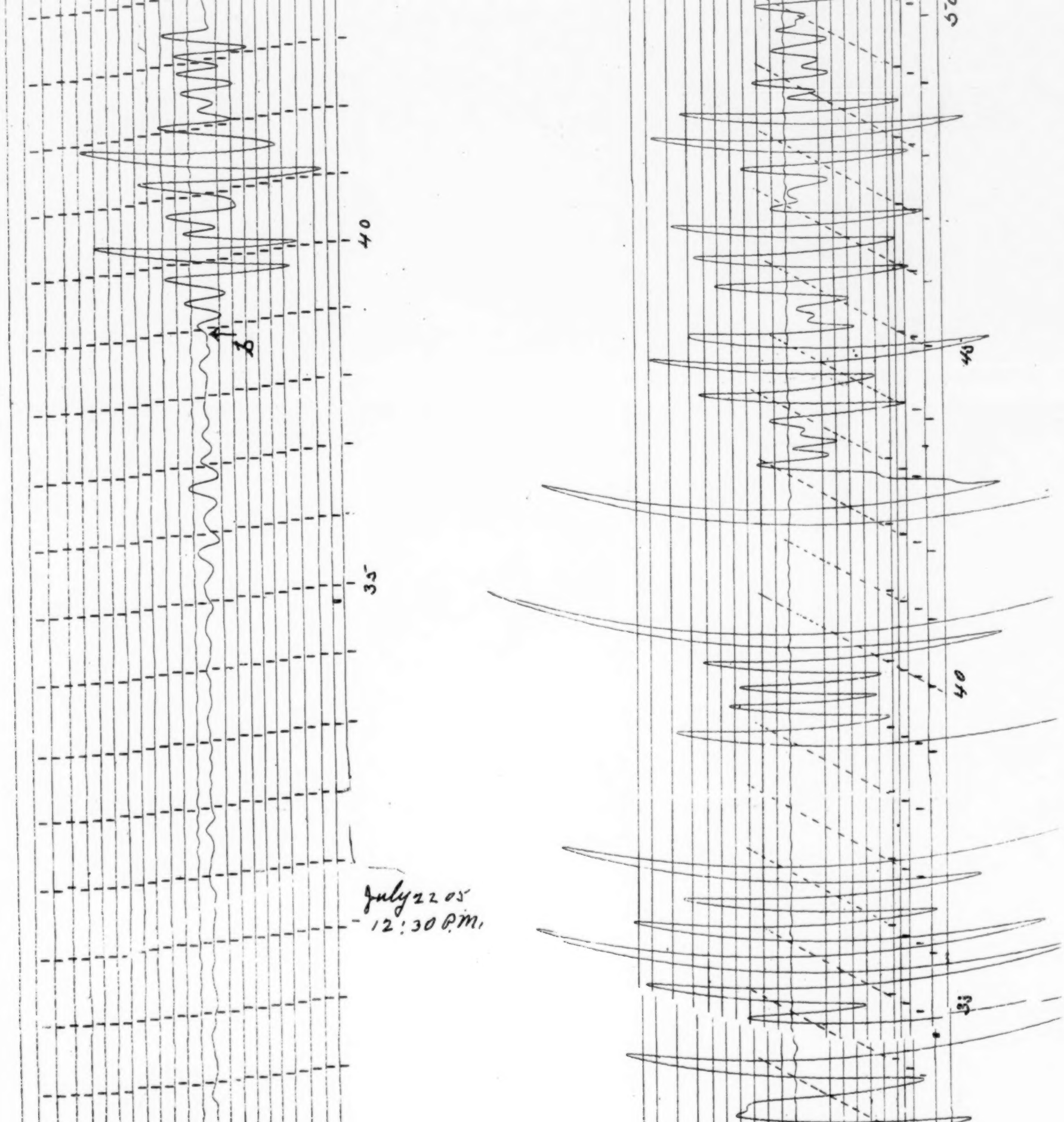
Plate I. Bosch-Omori Seismograph Record of Earthquake of July 22, 1905.
(Clock correction +3 seconds.)

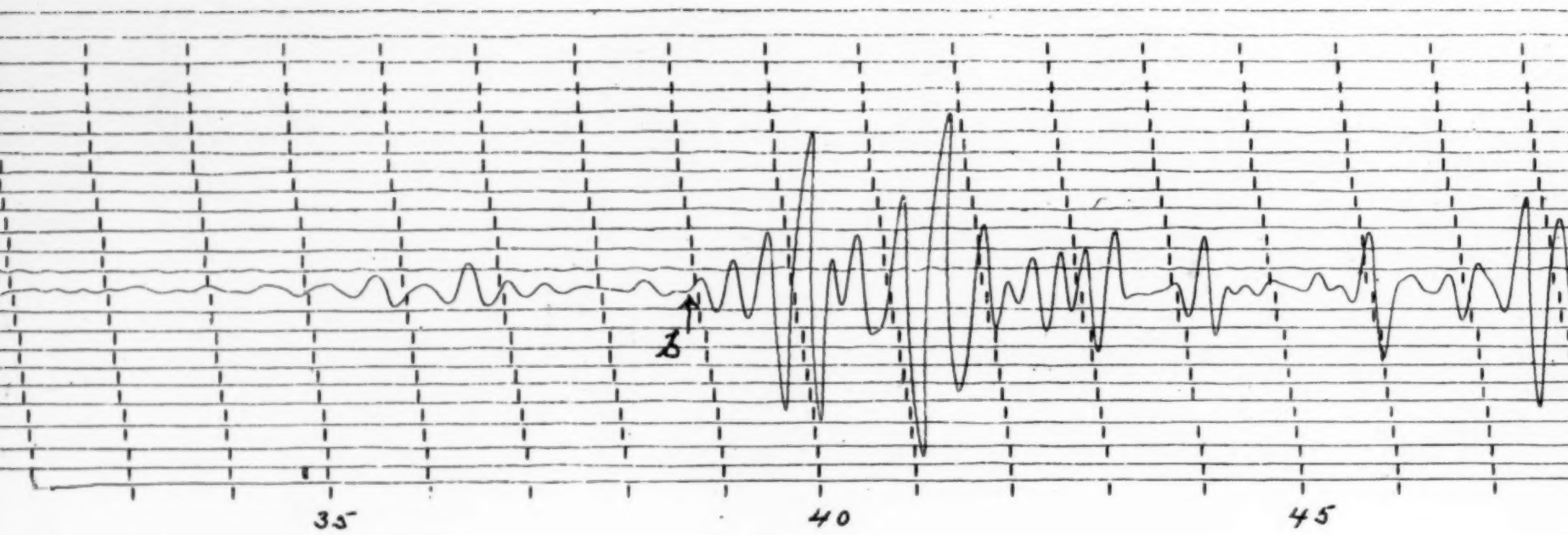





N
End
X
15
20
25
S


W
20
25
30
E


40
35
July 22 05
12:30 P.M.
45
40
35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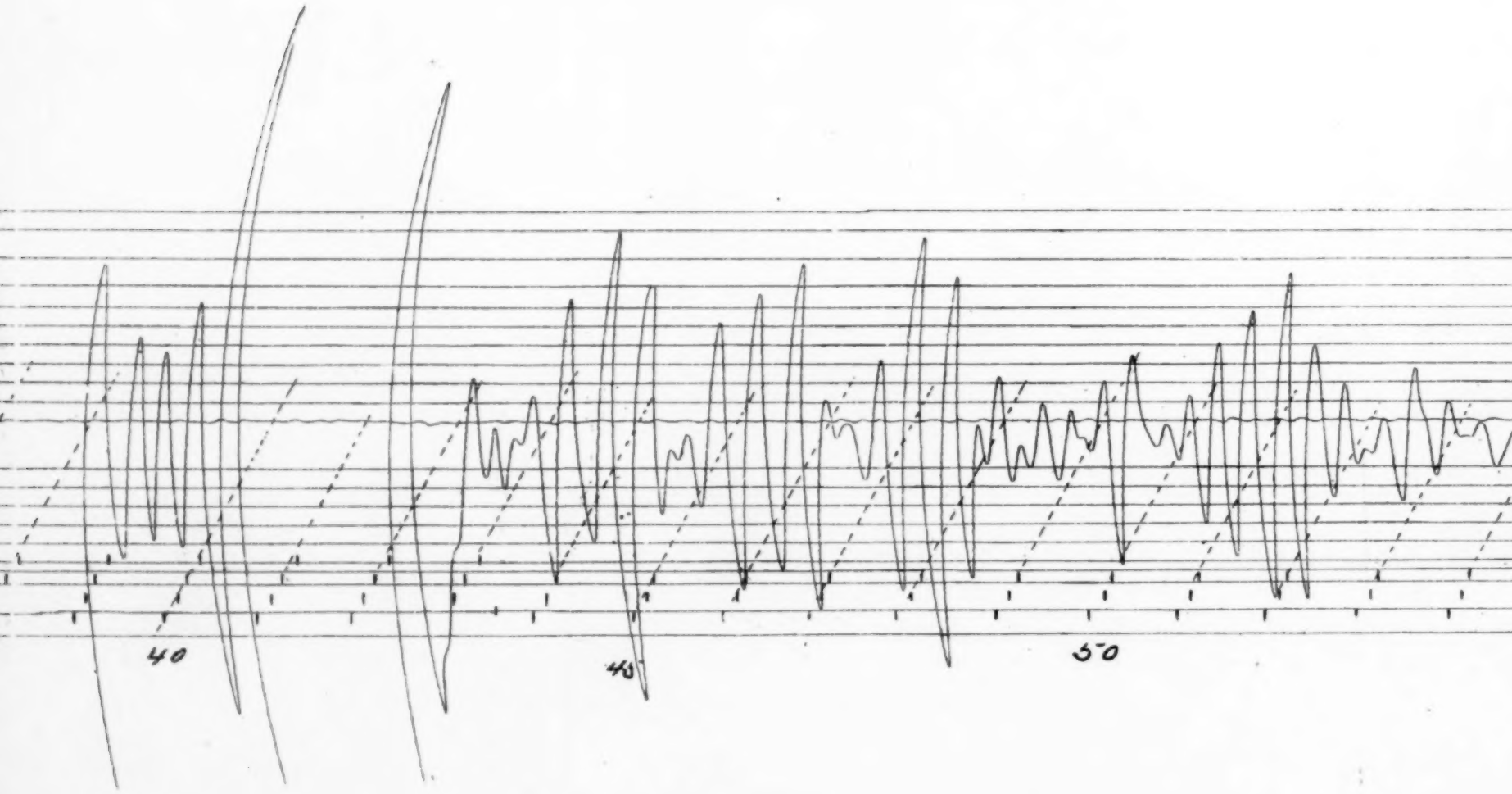
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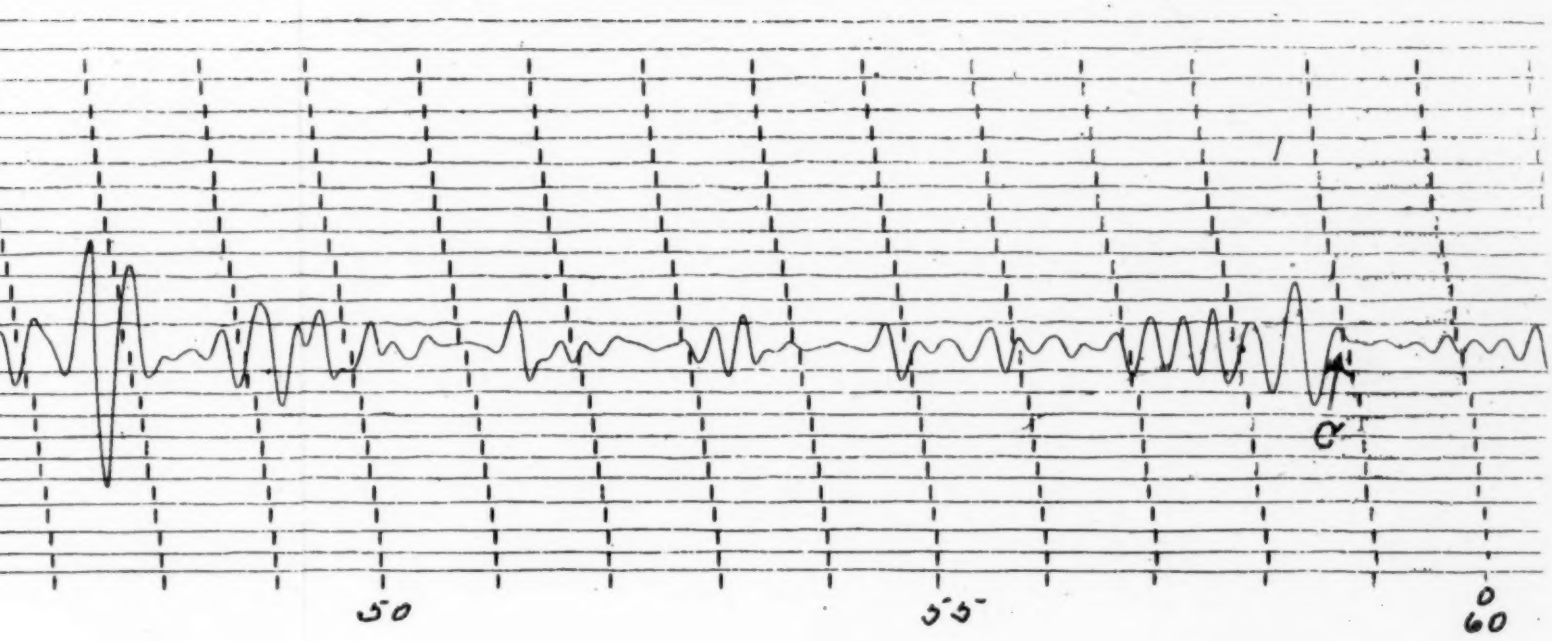
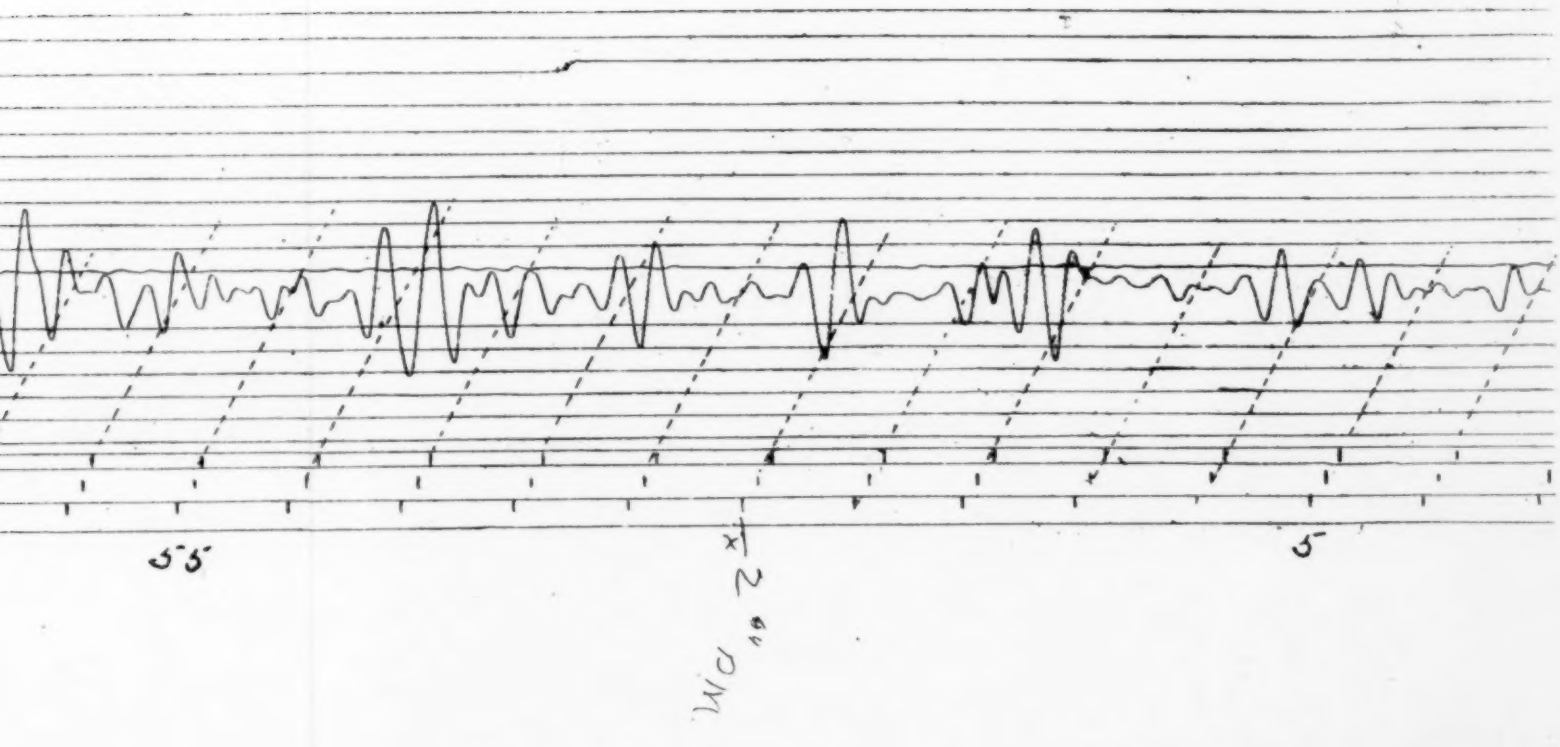
45
50

Plate I. Bosch-Omori Seismograph Record of Earthquake of July 22, 1905.
(Clock correction + 3 seconds.)

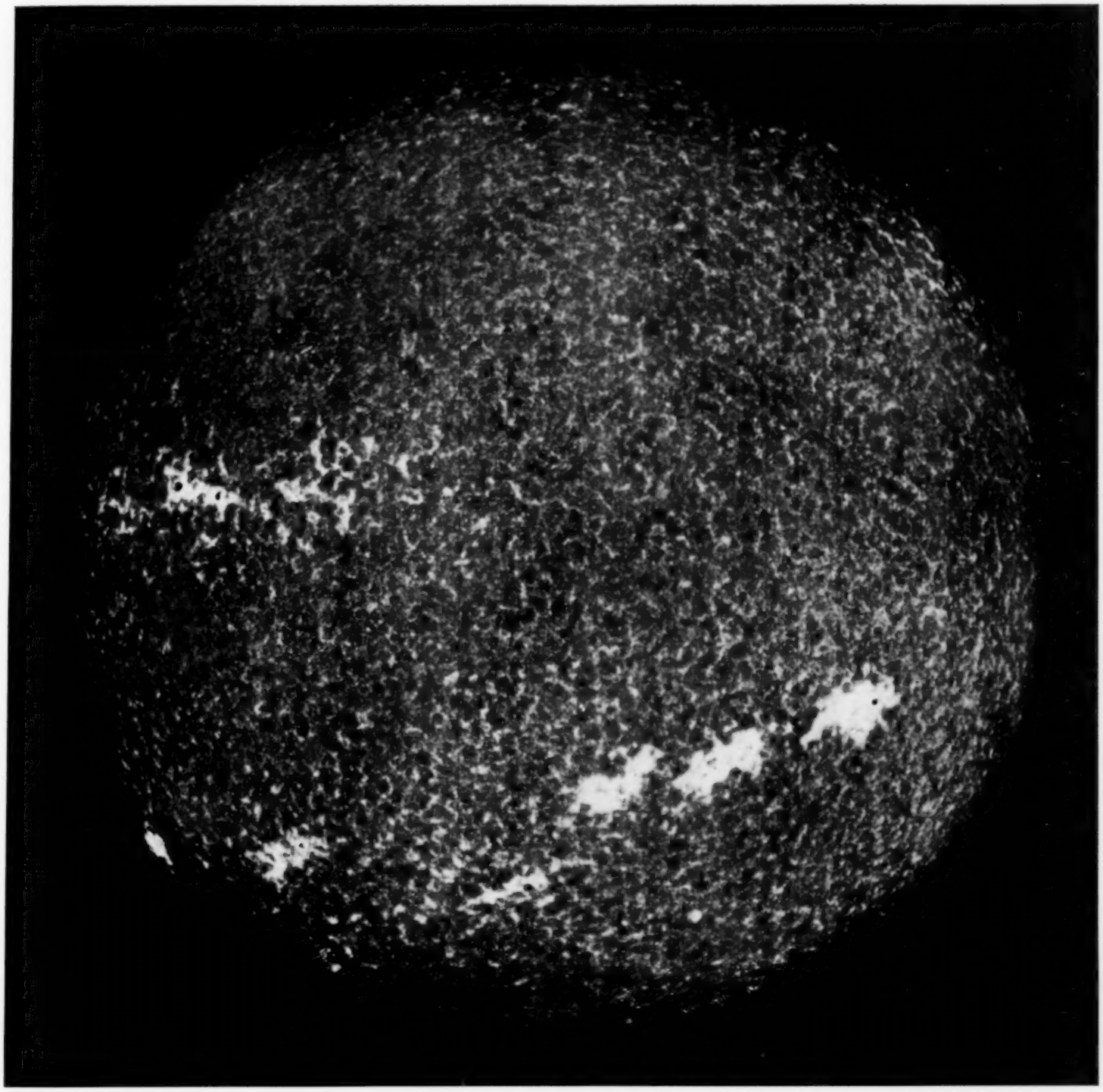




E

Plate II.

N



E W

S

FIG. 65.—Spectroheliograph of the sun, August 12, 1903, taken at the Yerkes Observatory, showing the spots, flocculi, and general appearance of the bright surface of the photosphere.

Plate III.

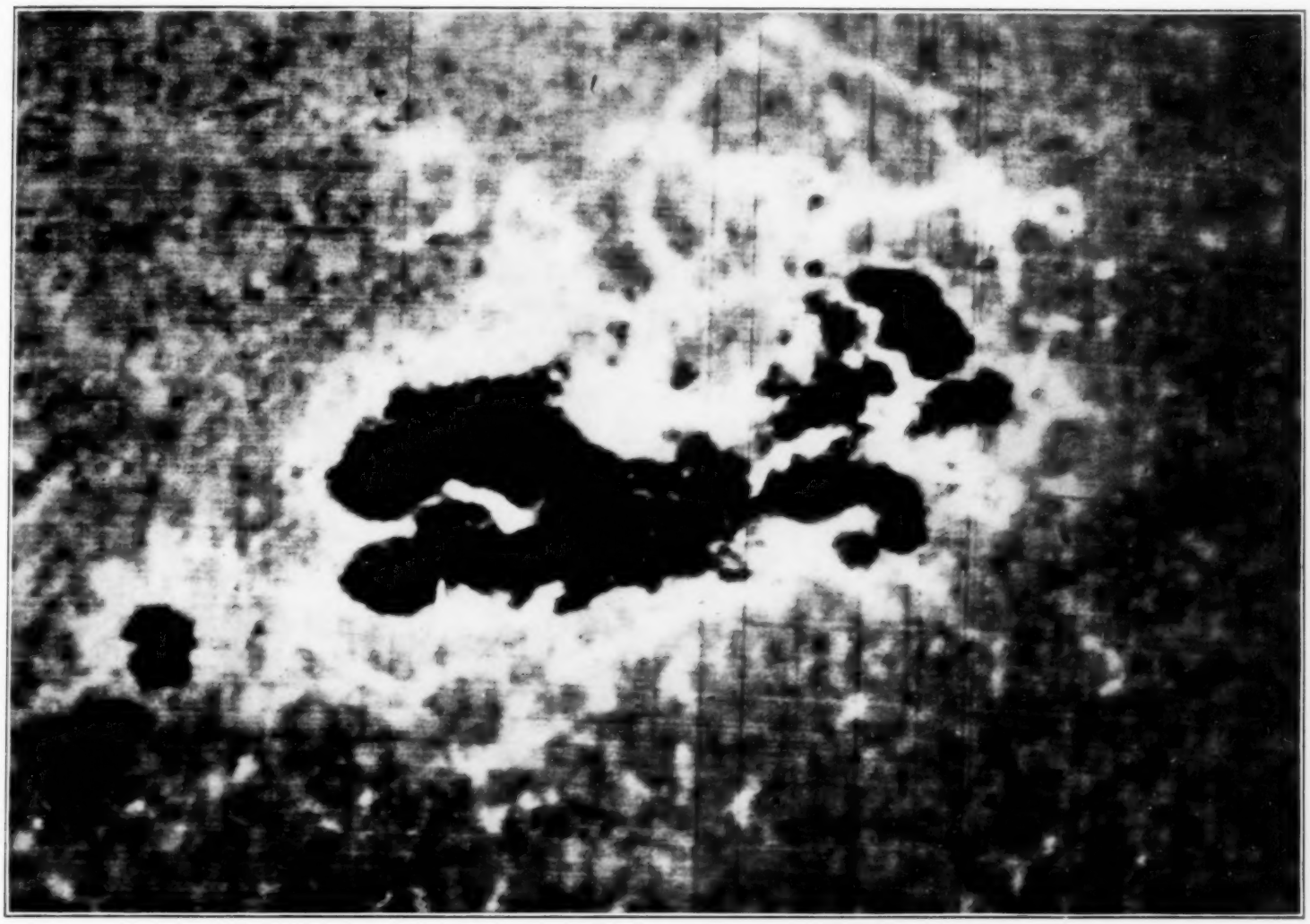


FIG. 66.—Spectroheliograph of the sun spot of October, 1903, showing the calcium flocculi surrounding it.

FIG. 67.—Typical forms of the solar prominences or red hydrogen flames.

Plate IV.

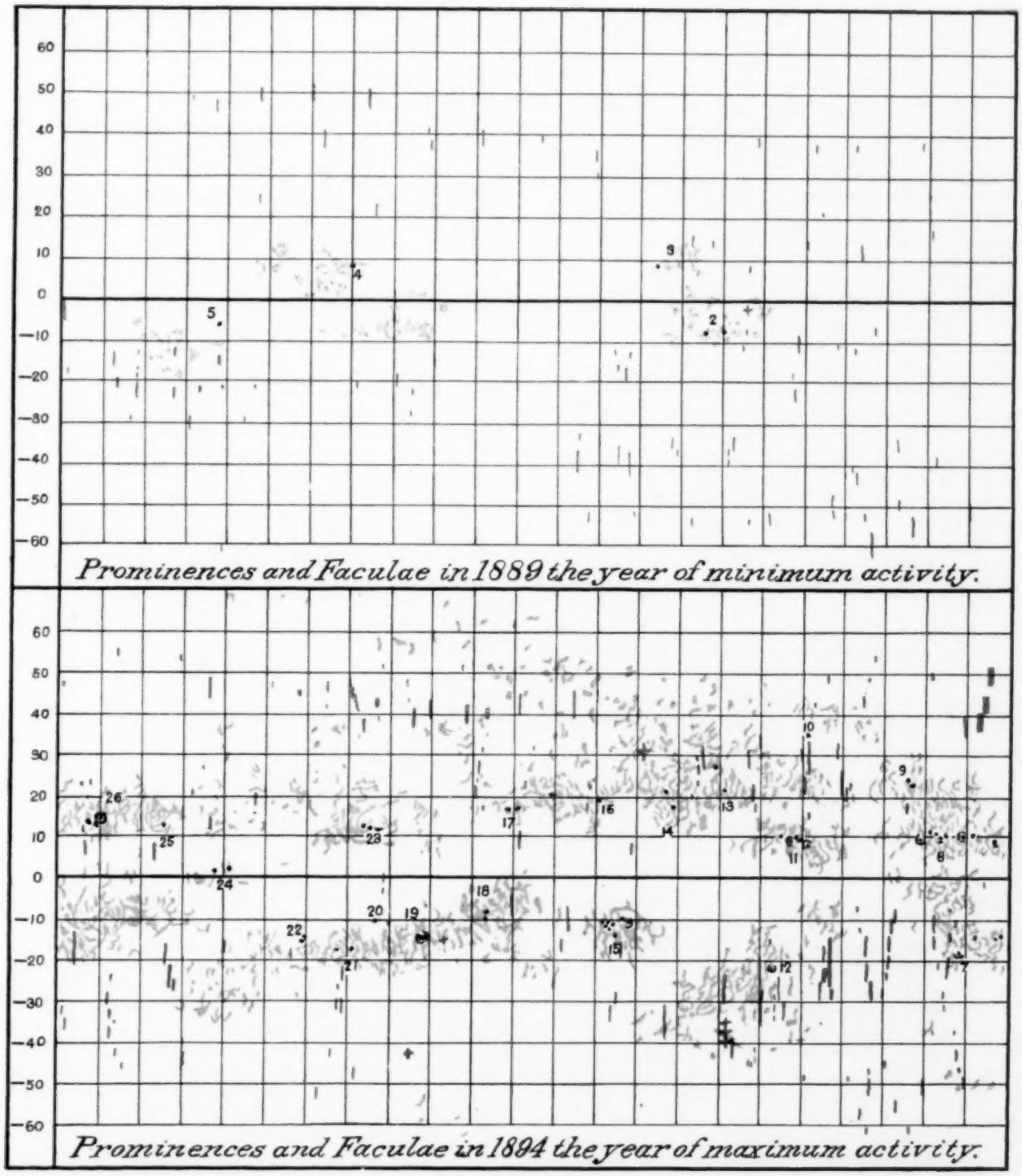


FIG. 69.—The frequency and size of the faculæ and the prominences change from year to year, as shown by examples from the minimum in 1889 and the maximum in 1894. Faculæ in blue. Prominences in red.